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That Will Pep
Up Windows****First Looks: FoxPro
For Windows
Heats Up the
Database Wars****12 Utilities That
Capture, Convert,
And Compress
Graphics Files****MAGAZINE**

DOS 6

The Ultimate Upgrade?

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Backup Disk Optimization Multiple Configurations****PLUS:** How Novell and IBM
Will Respond**Top Tips for Getting the Most
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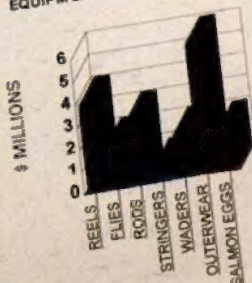


Ferguson and Bardell, Outfitters Monthly Sales Projections.

SUMMER PRODUCT LINE

Ferguson and Bardell, Outfitters is projecting increased sales volume based on the introduction of our new line. A complete line of graphite rods, reels, sportsman's pocketed vests, durable waders, Vermont wicker creels, stringers, gourmet salmon eggs, and hand-tied flies will be available at retail this spring. Attention to detail and quality should place F and B fly fishing equipment at the top of every angler's list. Western region projections for the new line are included here. Samples of the new fly fishing line will be available at the upcoming Western sales conference in Coeur d'Alene next month. Another F and B favorite, our classic hexagonal nylon tent, has been redesigned to be more colorful than ever. Plan to review both of these exciting new product lines. The complete Ferguson and Bardell, Outfitters catalogue will be available to you at the conference, as well.

EQUIPMENT SALES PROJECTIONS

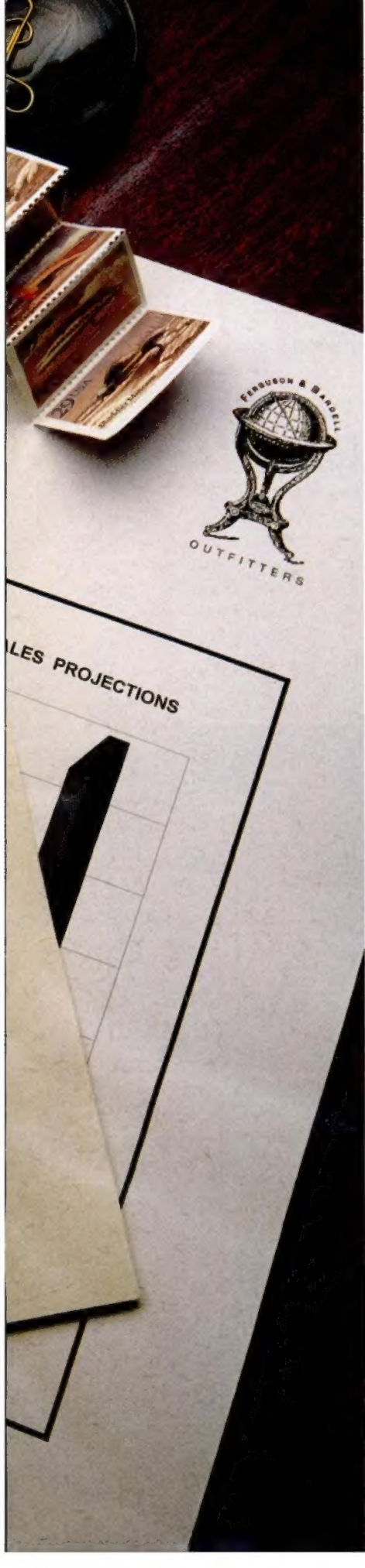


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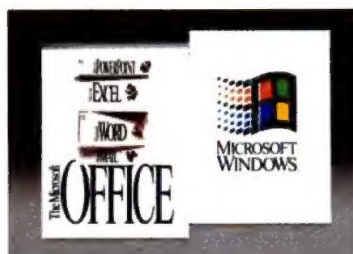
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Inside

This issue's cover trumpets our coverage of Microsoft's DOS 6, the latest version of the operating system that drives the vast majority of PCs in the land—and drives quite a few users to command line distraction.

As this issue reaches your hands, the software is actually shipping to users. Tying our editorial output to the vagaries of shipment dates is a high form of brinkmanship. We do it because we believe that while our mandate is to review shipping products, you are most interested in these products as soon they become available. In publishing, timeliness (and accuracy) is next to godliness.

Staff editor Carol Levin, a three-year veteran of *PC Magazine* who edits columnists, First Looks reviews, and the Read Only book-review section, drew the task of putting together our coverage of DOS 6. Beginning last October, she lined up seven writers, assigned them tasks, and sent them home with an early beta version of the new software. Meanwhile, our labs began to conduct some rigorous testing.

As the authors and editors became familiar with DOS 6, the electronic messages flew fast and (often) furious. If there ever was a virtual corporation, to borrow a pair of current buzzwords, it was the editorial team that worked on this story. With con-

tributing editors Jeff Prossie and Barry Simon in Tennessee and Southern California, respectively; contributor Bob Flanders near Washington, DC; and senior editor Chris Barr in Northern California; e-mail was often the only way to hold a task-force meeting.

Levin had to time the story to the product's official shipment



Staff editor Levin managed our DOS 6 coverage with great calm—essential for dealing with Microsoft.

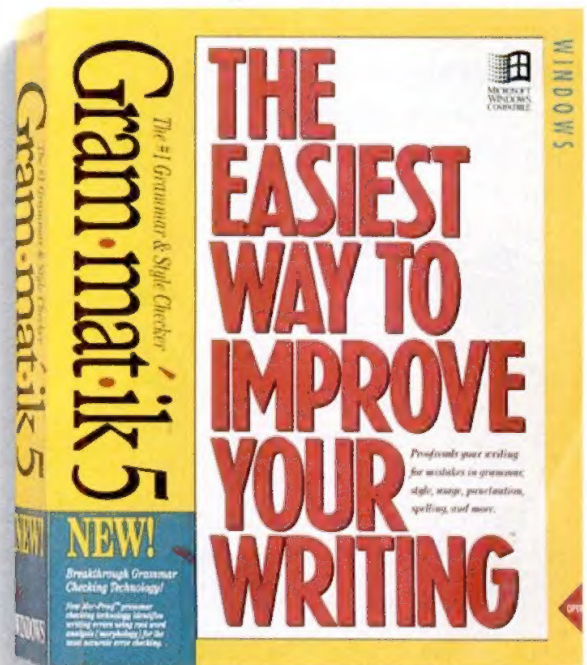
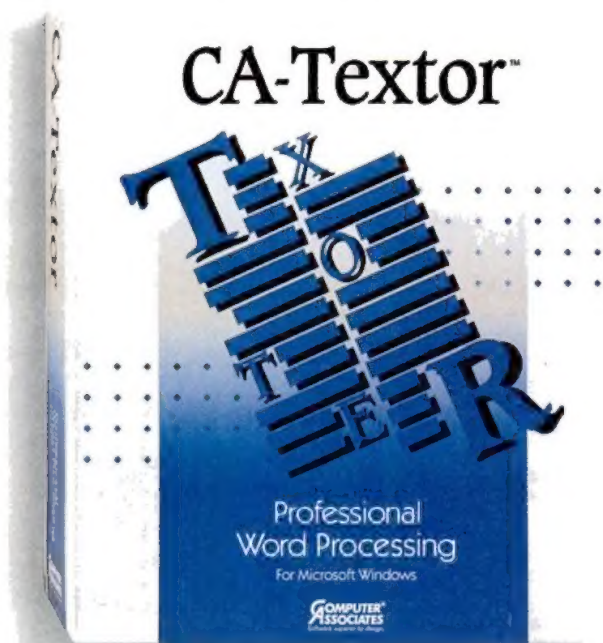
date. "They moved their ship date a couple of times," she says. This affected our lineup of other stories for upcoming issues. Here is where the story editor and story coordinator can shine. Levin did, performing both roles with great calm and determination.—Joel Dreyfuss

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Inside

DOS Brinksmanship4

Letters

The real meaning of integration19

Trends

- Printers talk back
- Local-bus battles
- SGML comes to the PC
- Made for multimedia29

First Looks

- FoxPro 2.5 for DOS and Windows
- Utilities vendors respond to DOS 6
- Office IQ37

New and Improved

BY BRAD GRIMES59

Read Only

EDITED BY CAROL LEVIN71

Toolkits

EDITED BY TRUDY NEUHAUS...77

COLUMNISTS

Michael J. Miller

Are You Connected?81

Bill Machrone

Hi, It's Me!87

John C. Dvorak

More Bonehead
Marketing93
Inside Track95

Jim Seymour

When Works Packages
Work99

Bill Howard

Price Wars: Still
Simmering105

COVER STORY

DOS 6: The Ultimate Software Bundle?

BY JEFF PROSISE Operating-system upgrade or utilities bargain of the year? DOS 6 will double your hard disk capacity, manage memory, back up files, and protect against viruses. It delivers easy access to a new level of performance but may be too tame for real power seekers. *PC Magazine* considers the third-party options.....108



Hard Disk Compression116	Twelve Tips to Get the Most Out of DOS 6122
Memory Management.....119	Coming Attractions:
Backup128	Novell's DOS124
Antivirus130	DOS 7 Wish List139
Hard Disk Optimization140	IBM Readies New DOS.....142
Multiple Start-up Options.....142	DOS 6 Annotated File Listing146
Highlights110	
Features Comparison116	

Cover illustration (top right) by Jean Tuttle

Hardware

Graphics Accelerators:
Waking Up Windows

BY JOHN R. QUAIN

There's no longer any reason to put off buying the graphics accelerator you need to wake Windows up to full alarm speed. Performance is up and prices are down: Among the 32 accelerator cards reviewed here are products that will burn rubber without burning a hole in your pocket.....158

The S3 86C801 Gang

Actix GraphicsEngine

32 Plus.....166

Diamond Stealth 24.....166

Focus 2 the Max TrueSpeed...166

Genoa WindowsVGA 24+.....166

Metheus Premier 801.....166

Mirage Storm 1280/256.....166

Nth S3 Advantage.....166

Orchid Fahrenheit VA.....166

Video Seven WIN.PRO.....166

S3's Latest: The 86C928

Actix GraphicsEngine Ultra...185

Artist Graphics WinSprint

900 Lite.....185

Diamond Stealth Pro.....185

ELSA Winner 1000.....185

Metheus Premier 928-4M.....185

Number Nine #9GXE.....185

First of the IIT Wave

Hercules Graphite Card.....199

Proprietary Solutions

ATI Graphics Ultra Pro,

EISA Version.....200

Compaq QVision 1024/E.....200

At the Rear: The S3 86C924

Advanced Integration Research

Aview 2.....204

Advanced Integration Research

Aview 2E.....204

Colorgraphic Twin Turbo

Accelerator.....204

Linwen/Gaintec GXA.....204

PCG Photon 70/70 Deluxe.....204

SixGraph Wizard 924.....204

A Move Up but a Step Behind

Boca SuperX Accelerator

VGA.....206

Cardinal VideoSpectrum XL.....206

Edge D24 BitBlaster Plus.....206

Genoa WindowsVGA 24.....206

The Lone Weitek Player

Alpha ASL Lightning

SVGA.....218

Coprocessed Performance

Hercules Superstation

XP610.....218

MicroStep AGC-2075e.....218

National Design Volante

AT800.....218

Highlights: Graphics

Adapters.....161

Editors' Choice.....164

Performance Tests.....170

New Accelerator Chip on the

Horizon.....183

The Shape of Boards

to Come.....184

Summary of Features.....186

Graphics

The Image Crusaders: 12 Screen
Capture & Conversion Utilities

BY LORI GRUNIN

Graphics file utilities can help sort through the glut of file formats pervading today's marketplace. With basic capabilities like screen capture and file conversion and more advanced ones like color mapping and gamma correction, they fill the gaps in your graphics toolbox.....221

PicturEze with CaptureEze.....226

Pizazz Plus.....226

Conversion Artist.....238

DoDOT.....239

FreezeFrame.....240

HALO Desktop Imager.....241

HiJaak.....243

HiJaak for Windows.....243

ImagePals.....249

ImagePrep.....249

Paint Shop Pro for Windows...254

Window Painters' SnapPRO!..258

Suitability to Task.....222

Editors' Choice.....223

Putting the Squeeze on

Images.....224

Troubleshooting

Conversions.....230

Summary of Features.....232

Nearly half of the 32
surge suppressors we
tested at ZD Labs
stopped everything we
threw at them.
Half didn't.



Hardware

Surge Suppressors: Cutting
Surges Down to Size

BY WINN L. ROSCH

We tested 32 surge suppressors, ranging in price from \$12.95 to \$265, and found that only about half of them are up to the task of stopping an electrical surge before it damages or destroys your valuable computer equipment...261

Highlights.....262

Editors' Choice.....263

Thumbs Up/Thumbs Down...264

Surge Suppressor

Product List.....270

Summary of Features.....278

Performance Tests.....284

TECHNICAL COLUMNS

User-To-User



BY NEIL J. RUBENKING A complex batch file that lets you sequentially perform a command on a group of numbered files289

Tutor



BY JEFF PROSISE The Truth About Free System Resources295

Lab Notes

BY MARK DOUGLAS Communications Programming in Windows 3.1.....299

Utilities



BY JOHN DEURBROUCK Catalog Your Windows Fonts with ENTPRN306

Environments



BY CHARLES PETZOLD Outline Font Selection in OS/2 Programs.....313

Power Programming



BY RAY DUNCAN The Hazards of Exploring Evolving Environments325

Solutions

PCs

Is there an inarguable answer to the question of whether or not large-capacity hard disks should be divided into multiple partitions?342

Operating Environments

Don't lose track of the time—here's how you can keep the clock visible in Windows 3.1; locating graphics accelerators for OS/2.....343

Word Processing

A way to copy equations easily and edit them with WordPerfect's full kit of editing tools.345

Spreadsheets



Create 3-D effects on Excel worksheets with a macro that simplifies the process.347

Databases



How FoxPro's FILE() function really works; a confirmation for the Del key in Paradox349

Graphics

Getting type to align across multiple columns in PageMaker 4.0 might not seem like an easy task, but it can certainly be done.356

Networking

How to make your modem and stand-alone fax share one phone line.360

Languages



Use high-intensity background colors in your BASIC programs362

AFTER WORDS

After Hours

Multimedia at home: five reasons to buy a CD-ROM drive

- InterOptica Publishing's Great Wonders of the World, Volume 1
- Macmillan New Media's Macmillan Dictionary for Children
- McGraw-Hill's Multimedia Encyclopedia of Mammalian Biology
- The Software Toolworks' The San Diego Zoo Presents... The Animals!
- Icom Simulations' Sherlock Holmes, Consulting Detective, Volume II...438

Abort, Retry, Fail?

BY ROBIN RASKIN.....442

ALSO IN THIS ISSUE

Direct Marketing Connection.....	333
Marketplace	405
Premier	405
Classified	416
Reader Service Card	425
Business Cards.....	427
Index to Advertisers.....	433
Advertisers' Product Index	434
Coming Up.....	436
Editorial Product Index	437

Guess what this is!
Nope, guess again.
Nope. See page 442
to find out.



The multimedia way to see the world's wonders (page 438).

If I'm terrified, will it show in my presentation
okay? What would happen if I put too much
company logo be in every slide? Visuals?
care? Can clip art help make things clearer?
of bar charts? Do borders distract from the
me look professional, but not too stuffy,
logos? Am I asking too many questions?

ion? Is white type on a black background
ch or too little text on a chart? Should the
What is a film recorder, and why should I
Will anybody care if I use pie charts instead
message? Or me? Which typeface makes
but not too casual? Did I already ask about
Am I forgetting anything?

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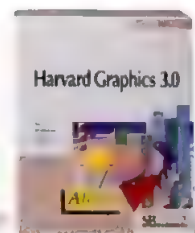
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Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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*PC World, February 1993, Review of 486 Systems
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According to Mr. Magoo, there's no trick to spotting a reliable monitor. You just pick one from a manufacturer that has met the stringent ISO 9000 series of standards for quality. And displays the ISO 9000 seal. The way Samtron does.

In fact, Samtron was awarded ISO's highest rating: ISO 9001. One of the very few monitor manufacturers in the world to ever earn it.

To achieve that rating, we underwent 1½ grueling years of auditing ordered by the Geneva-based International Organization for Standards (ISO). Everything we do was scrutinized. From design and manufacturing through packing and shipping.

Their high rating means that, with the possible exception of advertising, they approve of what Samtron does. The way we train our people. The way we keep our records. Our management. Our delivery. Our overall product quality. About the only thing they weren't quite sure of was Magoo.

Gads, Two New Flat-Screen Monitors.

With our world-class ISO credentials clutched in hand, we present our new high resolution flat-screen, color monitors. The SC-528DX multi-mode 15". And the SC-726V, our 17" with 0.26 dot pitch. These monitors have pictures so big and so sharp that even Mr. Magoo's eyes can see them. All the way out to the corners. Without distortion. Which makes them ideal for viewing Windows™ or CAD/CAM. If your needs are smaller look at our

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ESA
ESD
ESD
ESD

Along with our ISO 9001 rating, Samtron's entire line of monitors gets the Mr. Magoo seal of approval. It separates the leader in monitor technology from all the rest.

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SAMTRON

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Letters

INTEGRATION SHOULDN'T OFFEND YOU, DVORAK

I have to object to a couple of points in John C. Dvorak's "Suckered Again by Trickery" (February 9, 1993). The term *integrated* may make him cringe, but for me and many others its connotation is a positive one that brings to mind not the civil unrest brought about by segregation, but the civil peace that integration is intended to bring about.

As to his dismissal of integrated software, I use an integrated program and it has given me multitasking capabilities without taking up large amounts of memory. And while none of its various components may stand at the top of their "breed," as a team, they excel.

John O'Roarke
Oak Lawn, Illinois

LEARNING TO KEEP YOUR COMPUTER IN YOUR POCKET

After reading John C. Dvorak's "Privacy, Schmivacy" (January 26, 1993), I came to the conclusion that Mr. Dvorak must have been run off the road on his way to work by some boob using a car phone. I look forward to and welcome the technological advancements in communications that Mr. Dvorak decries but feel that we should all understand that it is the receiver, not the caller, who must be in control.

While there are unfortunate boors who will continue to flaunt their inflated self-importance with flashy doodads in the same way they wear their ostentatious jewelry, I believe people will begin to learn how to use these portable devices with good taste and consideration for others.

Richard Demers
Rochester, Minnesota

TED WILLIAMS? HA!

After reading and enjoying Bill Machrone's "Ted Williams and the GUI" (January 12, 1993), I took a look at the accompanying illustration and nearly fell out of my chair laughing! Ted Williams? This guy looks like a bench warmer named Bruno.



***"Integrated" makes
Dvorak cringe, but others
find it positive.***

First of all, Ted Williams batted left handed and was rail thin, hence the nickname "Splendid Splinter." Also, he would never wear a batting glove, let alone two!

Luckily your illustrator wasn't commissioned to do the Elvis stamp because Elvis would have wound up looking like Bill Gates.

John T. Bishop
Yalesville, Connecticut

DEC STs ARE STILL AVAILABLE

Your article "Upgradable PCs" (December 8, 1992) contained inaccurate information regarding Digital Equipment Corp.'s DECpc 400ST family. You stated that Digital had stopped selling the STs and had replaced them with the new LP line. This is incorrect. Digital will continue to sell its ST family of computers along with the LPs.

Michelle Hoey
Public Relations Specialist
Digital Equipment Corp.
Acton, Massachusetts

JUST THE RIGHT FACTS

In the review of Tech Hackers Inc.'s financial @nalyst package in "Application Add-Ins: Mix-and-Match Featureware"

(February 9, 1993), there were several factual errors.

The otherwise favorable review is qualified with a statement that says that the financial @nalyst's NETPV function can only handle fixed period interest rates and equally spaced cash flows. In fact, the @functions in financial @nalyst not only handle varying discount rates and uneven cash flows with uneven time lengths, they also allow you to group like payments together for concise specification. Filtering of cash flow is also an option.

The phone number listed for Tech Hackers is also incorrect. The correct number is 212-344-9500.

Jacqueline Mezzani
Director of Marketing
Tech Hackers Inc.
New York, New York

A CALL FOR AMBIDEXTERITY

While I enjoyed reading about RCLICK in your recent Utilities section (February 9, 1993), I was really annoyed that you kept referring to the "right" and "left" mouse buttons. I'm left-handed, and my mouse buttons are switched so whenever I read "right button," I have to stop and remember that, for me, it means the left button.

Right-handed people probably think this isn't a big deal since only about 10 percent of the population is left handed, but the fact remains that since mouse buttons have the ability to be switched, labeling them "left" or "right" is inaccurate and confusing.

How about referring to them as "primary" and "secondary" buttons? Since *PC Magazine* is respected as the leader in the computer publication arena, you should set a precedent and show the rest of the world how to do it right (I mean correctly).

Tina Koyama
Seattle, Washington

SELF-SELECTING SURVEY?

I think that the result of your PC MagNet survey regarding data compression products is somewhat misleading. In "DOS 6

If you can't tell the difference maybe you shouldn't pay



Laser Printer

OK, concentrate. Look carefully at the page on the left. It comes from a laser printer. Notice how clear and sharp the text and graphics are.

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LETTERS

to Double Hard Disks" (Trends, January 12, 1993), you say "In a recent PC MagNet survey, nearly 70 percent of the 1,139 respondents said they use at least one compression product."

Since PC MagNet users obviously have modems, it would seem likely that they also own compression utilities to help with uploading or downloading large files or programs found on BBSs. So while the survey may be accurate, it isn't representative of all computer users or even all the readers of your magazine.

*Eric Newman
Bethel Park, Pennsylvania*

• **The PC MagNet data represents power users. As the article said, "InfoCorp estimates that only 1 percent of the installed base uses compression today."**—Ed.

LAY OFF MY TRANSFORMER!

Please tell Bill Howard that his suggestions regarding laptop transformers in "Universal Confusion" (February 9, 1993), will push international users back a decade. He sounds like a power user who's completely out of touch with the real world or someone who hasn't blown out a transformer in a foreign country because of a power change.

Lay off my auto-sensing transformer! It may be affordable for you to buy two transformers, but many of us operate on a much tighter budget.

*Susan J. Griffey Brechin
New Orleans, Louisiana*

"FOR OS/2 1.3 COMPATIBILITY"

This is in response to your excellent article, "Demystifying CONFIG.SYS in OS/2 2.0, Part 1" (Lab Notes, February 23, 1993). I think you were confused with OS/2 1.3, when you discussed the MOVE/NOMOVE parameter of the MEMMAN command. Since OS/2 2.0 uses the 386 paged memory management scheme, there is no need to move pages around in memory. Only buffers used in DMA I/O transfer must be in contiguous locations in memory. In fact, if you had given the "help memman" command and then clicked on either the MOVE or NO-

MOVE parameters, a "These parameters are provided for OS/2 1.3 compatibility" message would have appeared.

*John K. Gotwals
Lafayette, Indiana*

• **You're essentially correct, but since most of the major OS/2 applications available today are still based on OS/2 1.3 and not the 32-bit memory model of OS/2 2.0, the end result for the user is the same.**—Ed.

NO ONE SWAGS LIKE THE GOVERNMENT

In "Abort, Retry, Fail?" (February 9, 1993), you attribute the buzzword "SWAG" (Stupid Wild-Assed Guess) to Dan Ness of Computer Intelligence. Obviously the PC Magazine sleuths have not spent

much time around federal government budget operations. We've been SWAG-ing for decades.

*anonymous federal employee
Boise, Idaho*

EAGERLY AWAITING

Your evaluations of word processors, databases, and spreadsheets are second to none. I would, however, like to see a comparative review of statistical software packages. PC Magazine could certainly shed light on this highly technical subject.

*M. R. Patel
Brooklyn, New York*

• **A comparative evaluation of 14 statistical software packages will appear in our May 11, 1993, issue.**—Ed.

CORRECTIONS AND AMPLIFICATIONS

In "On-Line Services: Making Meaningful Connections" (February 23, 1993), we stated that OZCIS is free for personal use. This is true only if you download the program from CompuServe or ZiffNet. If you order the program directly from the author, it will cost \$20 for a disk with the program and a documentation file, or \$30 for a disk with the program and printed documentation. We also inadvertently omitted Steve Sneed's CompuServe user ID (70007,3574), where you can contact him for more information.

In "Application Add-Ins: Mix-and-Match Featureware" (February 9, 1993), there were a number of factual errors: The list price for Prime, from Prime Consulting Group, should have been \$29.95. In the review of Alki Software Corp.'s MasterWord, the statement that "Alki Software Corp. actually created WinWord's standard 1.8MB help file..." is incorrect. In fact, MasterWord's help file system is built on the foundation of Microsoft Word's original help file.

Plustek USA Inc.'s ScanPlus-Color 6000 (First Looks, February 9, 1993) can support 24-bit color resolutions at 300- by 600-dots per inch.

The First Looks review of askSam for

Windows (February 9, 1993) should have been labeled as a preview.

We printed the wrong address for Genus Microprogramming (Toolkits, February 9, 1993). The correct address is: 1155 Dairy Ashford, #200, Houston, TX 77079; 800-277-0918.

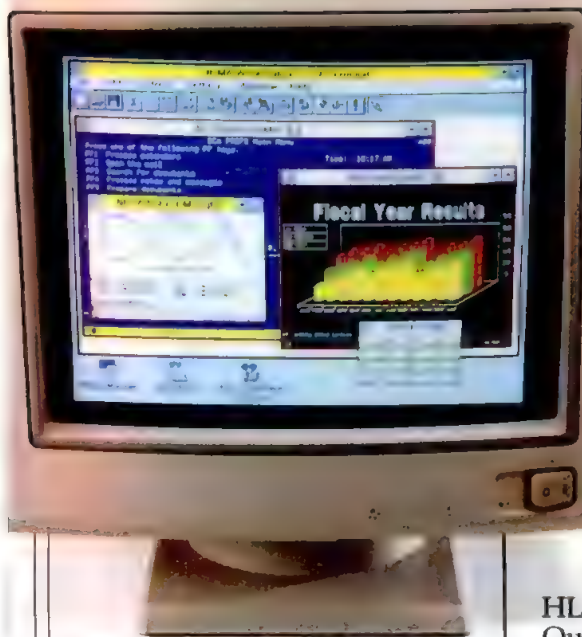
The phone numbers for Golden Software were left out in the Brief describing its product, Grapher for Windows (New & Improved, January 26, 1993). The phone numbers are 800-972-1021 and 303-279-1021.

In "Portable Computers: On the Road" (December 22, 1992), three notebooks were misplaced on the performance axis in the price performance chart. The Altima 433 should have been graphed at 120.7, the Polywell NB325T at 93.2, and the QSI Klonimus at 85.0.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, PC Magazine, One Park Ave., New York, NY 10016-5802, or upload it to PC MagNet (see page 12 for access information). All letters become the property of PC Magazine and are subject to editing.

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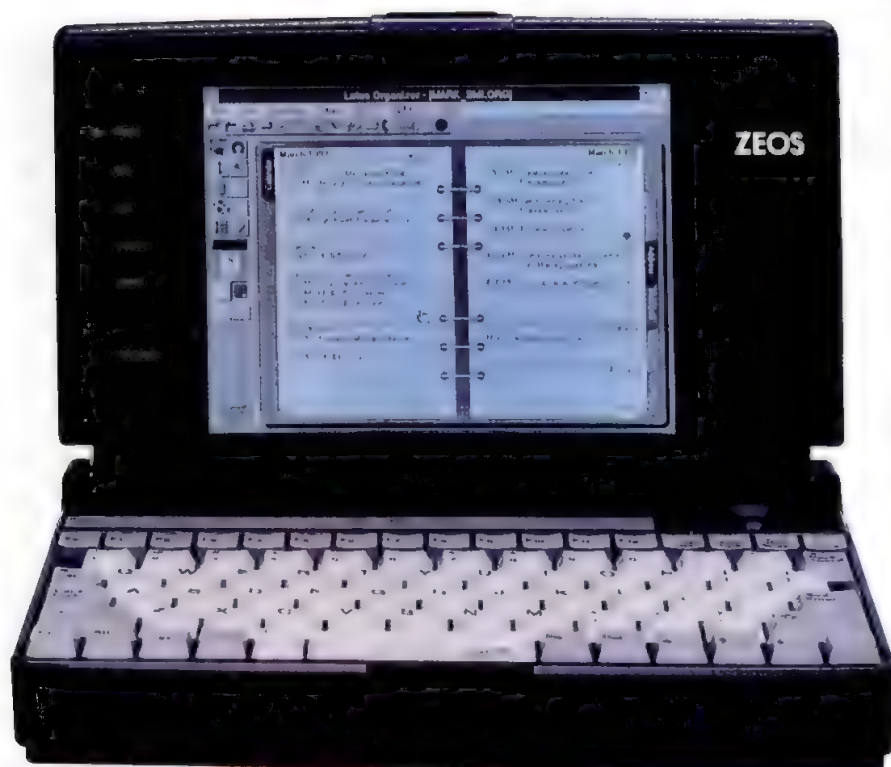
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Processor Speed	25MHz	10MHz	20MHz
RAM	2MB to 10MB	1MB to 3MB	2MB to 10MB
Hard Drive	80MB	40MB	60MB
Screen	VGA Backlit	CGA Backlit	VGA Reflective
Runs Windows	Yes	No	Yes
Built-in Pointing Device	Yes	No	No
Footprint	9.7" x 6.1"	9.8" x 5.9"	11.0" x 7.8"
24 Hour Support	Yes	No	No
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Monitors shown here are artistic presentations of the MAG MX15F model, which may or may not be the model used with the systems.

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PC

March 1993 Editors' Choice
MAG MX15F MONITOR

BEST PICTURE

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June 1992 Editors' Choice
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May 1990 Editors' Choice
MAG MX15F MONITOR

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BEST SUPPORTING ROLE



*January 1993 Editors' Choice
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GATEWAY 2000 4DX2-66V
(MONITOR MANUFACTURED
BY MAG INNOVISION)



*January 1993 Editors' Choice
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Best 18.5" Monitor
Best 18.5" Monitor



*March 1993 Editors' Choice
Best System*
Best 18.5" Monitor
Best 18.5" Monitor
HERTZ 486/D66X2E
(MAG MX15F MONITOR)



*March 1993 PC World
Best Buy System*
HERTZ 486/D66X2E
(MAG MONITOR)

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CIRCLE 067 ON READER SERVICE CARD



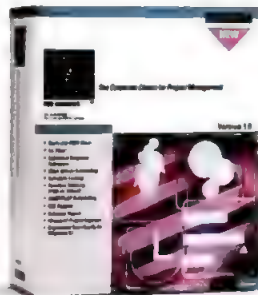
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CIRCLE 186 ON READER SERVICE CARD

Printers Talk Back

Fast "bi-di" parallel ports on the way.

A little over a year ago, Intel, Xircom, and Zenith Data Systems brought out a new parallel port that was four times faster than the old one. The Enhanced Parallel Port was designed specifically for SL-based notebooks and LAN adapters, but we predicted that fast par-

allel ports would also have a dramatic impact on desktop systems and printers (Trends, January 14, 1992). Now companies all over the printer market are working hard to deliver improved parallel ports. Not only are the new ports faster, they're also more communicative. Bidirectional communications allow printers to track jobs, tell you how many pages they've printed, and alert you when they're out of paper or toner.

On the hardware side, many efforts to improve the parallel port have come together under the auspices of the IEEE's working group P1284. The committee's specification is based on the "Boise" spec from Hewlett-Packard and Microsoft but was also developed "with significant input from Compaq, IBM, and Lexmark," according to Bob Hillis, who is the group's secretary. The HP LaserJet 4, which was introduced last fall, adheres to the specifications, and many more printers are expected shortly.

Unfortunately, the same vendors that are cooperating at the hardware level are still fighting for control over the software interface. The Network Printer Alliance—led by Lexmark and including IBM, Insight Development, Intel, and Texas Instru-

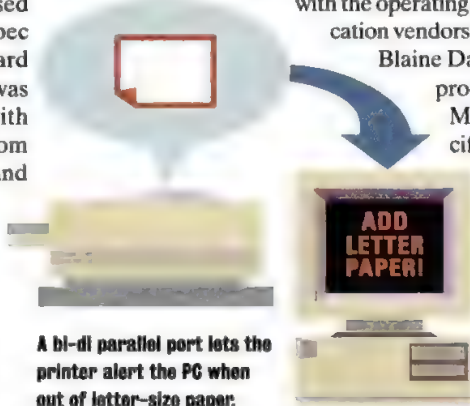
ments—has defined a software protocol that lets printers and PCs talk to each other over the network. Printers that support the protocol should show up later this year. The protocol "is not limited to printers," says Jim Greene, director of Lexmark's connectivity center. "It's independent of page description language, printer technology, and communications interface. Scanners and fax machines can use it too."

But the NPA lacks two players key to its success, Hewlett-Packard and Microsoft. HP attends NPA meetings but isn't an official member because, "We prefer to work directly with the operating system and major application vendors such as Microsoft," says

Blaine Davies, HP's connectivity products manager. And Microsoft has its own specific ideas about how bi-di software should look and feel: Witness the Windows Printing System's animated Status window (see First Looks, March 30, 1993).

Although HP and Microsoft are vague about the direction of their joint projects, they seem to be leaning toward host-based GDI printers. Wherever they're headed, their combined clout makes it likely that the rest of the printer industry will follow.

—Mary Kathleen Flynn



PCI, VL-Bus, And 64-Bit

WHEN THE FIRST PENTIUM-BASED systems arrive in May, the Peripheral Connect Interface—Intel's answer to the VESA Local Bus—may get a boost in mind share but not in market share.

While Pentium-based computers will perform faster than same-speed 486s, system boards have to be overhauled to exploit the Pentium's 64-bit bus. And adding local-bus connectors demands more parts and more work. Most of the first Pentium-based systems will have ISA- or EISA-bus implementations, and if they do have a local bus, it won't be PCI.

Intel only released the final specs for the PCI card and socket connectors in February. Optimistically, the first PCI systems will be available in early summer, and odds are that these early systems will use 486 chips, not Pentiums.

According to Intel, the 66-MHz Pentium chip's 64-bit bus is ideal for pushing high-bandwidth applications through to the display, or to I/O devices such as hard disks. Intel CEO Andy Grove touts Pentium as a platform for decoding Intel's Indeo video technology. Although PCI is a 33-MHz, 32-bit bus, Intel's new PCI chip set can run on the Pentium's 64-bit data bus.

The local bus wars are far from over. VESA, the early leader, is working up a 64-bit bus version of its own for the VL-Bus, with products that are based on it due out at year's end. —Christopher Barr

ATM: Made For Multimedia

ORIGINALLY A KEY TECHNOLOGY in the ever-elusive ISDN, Asynchronous Transfer Mode (ATM) has been around as a concept for a decade, traditionally in the context of wide area networks. But increasingly, the protocol is being explored for its potential in local area networks, where it may generate a class of desktop services and applications

Pipeline By Robin Raskin

Peer-to-Peer Grows Up

Early peer-to-peer networks were adopted primarily by what we call the SOHO (Small Office, Home Office) crowd. If you didn't have the wherewithal to support a full file server based network, you opted for a peer-to-peer net. You could share data, disk drives, and printers. If you weren't in any horrible rush, you could even share applications—all without installing special server software on a dedicated file server.



A quick glance at today's networking market shows that peer-to-peer networking is no longer the poor relation. As it becomes more secure, more compatible, and more open, the peer-to-peer model is fast becoming a serious networking choice.

To this end, peer-to-peer networking services are becoming integral parts of operating environments. When you install these systems, you are automatically a client in a peer-to-peer situation. Companies such as LANtastic developer Artisoft, once the bastion of peer-to-peer systems, are being squeezed as environments start to support standard transport protocols such as SMB (System Message Block) and NetBEUI.

In case you haven't been keeping a tally: Macintosh System 7, Windows for Workgroups, Univel's UnixWare, and the

upcoming Windows NT all ship with peer-to-peer networking in the box. Windows for Workgroups and Windows NT both include e-mail and scheduling apps. Eventually, Windows for Workgroups and plain-vanilla Windows will merge, making networking and networking apps ubiquitous in Windows. All signs indicate that network applications are about to show up in Personal NetWare, Novell's next incarnation of its peer-to-peer system, as well. OS/2 is the johnny-come-lately. Though we've seen some signs of peer services at various demonstrations, when and how they will work is still not clear.

During its beta test cycle, the upcoming MS-DOS 6.0 included a piece called the Workgroup Connection, which allowed DOS machines to become clients of Windows for Workgroups. It also included MS Mail and Schedule+ connections. In the eleventh hour Microsoft pulled the peer-to-peer facilities out of DOS 6, claiming they caused too much user confusion. Instead, Microsoft is offering The Workgroup Connection, a \$79.95 software package that performs the identical function. It's a pity that Microsoft, early proponents of the "networking-should-be-in-the-operating-system" school couldn't bring peer-to-peer to DOS. Microsoft also lost a bit of a competitive edge since vendors such as Performance Technologies and Tiara have DOS-based peer-to-peer products that can act as both clients and servers in the Windows for Workgroups setting. So look in your operating system, you're bound to find a peer.

Robin Raskin is an executive editor of PC Magazine.

users can't get today. ATM switches may be the best hope for providing LANs with the stable, dedicated connections that ultra-high-bandwidth multimedia applications will need in the future. And the technology seems destined to become the eventual choice for LAN-to-WAN connectivity.

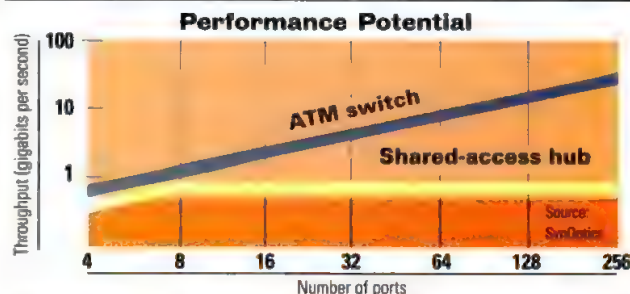
Today's 10-megabit-per-second Ethernet and Token-Ring LANs use shared media with a fixed bandwidth. Even Ethernet's much-anticipated 100-Mbps successors—FDDI, CDDI, and Fast Ethernet—use shared media with a fixed (though much higher) bandwidth. ATM, at 100-Mbps, uses dedicated connections with a variable bandwidth.

On a shared-media LAN, users compete for the same fixed bandwidth. On an ATM LAN, communications tasks negotiate for chunks of bandwidth, and temporary private connections are configured and reconfigured all the time. So while the performance of shared-media LANs degrades as you add users, performance on ATM LANs may actually accelerate, according to Bert Williams, product marketing manager for ATM at SynOptics.

Most applications can tolerate the performance inconsistencies of shared-media

LANs. But heavy-duty multimedia apps, such as real-time video conferencing and medical imaging, require the constant bit rate that an ATM LAN can provide.

Although the network hub makers insist that ATM is beyond the majority of their customers' current needs, they are nonetheless introducing products at a steady clip.



Shared-access LAN performance levels off at eight users, but ATM networks speed up as users come on-line.

Adaptive Corp. and Fore Systems are already selling ATM switches.

Cabletron Systems recently began reselling Fore Systems' switches and is developing more-advanced ATM products. Cabletron expects to deliver a "next-generation" hub that includes integrated ATM cell switching later this year. ATM adapter cards for the PC and Macintosh are due next year.

SynOptics has developed an approach called Fast Matrix ATM, which uses a parallel network of interconnected binary switching elements. The company expects to deliver ATM switching chip sets based on this approach shortly.

Ungermann-Bass recently announced an Ethernet scheme that it is calling "ATM-ready." Like ATM, the Virtual Network Architecture configures resources on-the-fly with switching modules called DragonSwitch for Ethernet. Ultimately, VNA will be extended to the Total Area ATM Network, with ATM switches being developed by Ungermann-Bass and BBN Communications.

Nobody expects ATM to be accepted immediately on a large scale. The price premium for ATM is still too high. Even Ungermann-Bass's ATM-like technology costs \$900 per port, compared with Ethernet's \$150 to 200 per-port cost. And it will be at least two to three years before the gap narrows, predicts Bill Clark, product manager for advanced technologies at Cabletron.

While the world waits for "ATM to the desktop," the technology holds much promise for backbone LANs and LAN-to-WAN connections. —Mary Kathleen Flynn

Documents Under Control

New File Formats

DESIGNERS SPEND A GREAT DEAL of time and money choosing fonts, colors, and graphics to give a document a certain look. But if you use special fonts, how do you make a computer-generated page look the same when it is displayed on another platform?

Many electronic publishing companies are trying to solve the sticky problem of cross-platform consistency of documents, some by supporting a mainframe standard called SGML (see next story), and others, most notably Adobe Systems but also the lesser-known No Hands Software, by developing advanced file formats.

Adobe's solution, called Acrobat (and formerly known as Carousel), is based on a subset of PostScript. Acrobat changes a document into a Portable Document File (PDF) that can be read on other platforms with the help of a special viewing utility.

No Hands' Common Ground uses the company's DigitalPaper technology. With Common Ground, the host computer's imaging engine (in Windows, the Graphics Device Interface, and on the Mac, QuickDraw) creates a replica of the original document and stores it in the DigitalPaper file format.

In an effort to reduce paper output, the files produced by Acrobat and Common Ground can be distributed electronically—via e-mail or a modem, or on disk or CD-ROM—and can be viewed with proprietary utilities. They retain the look of the original document, and both company's file formats can be searched, annotated, and printed. Neither can be edited directly, but the text can be copied to another app, such as a word processor, for editing.

Both technologies produce files that can be viewed on platforms other than the ones

on which they were created. Common Ground, available initially for the Macintosh, will have both Windows and DOS versions ready later this year. Acrobat, which is due soon, will operate initially under Windows and on the Macintosh. File viewers that work under DOS and Unix will be made available later this year.

—Christopher Barr

Old Mainframe Standard

THE STANDARD GENERALIZED markup language (SGML), the ISO electronic-publishing standard widely used in the mainframe environment, is finally making its way to the PC.

SGML is a system for assigning tags to the structural elements of a document. It allows documents to retain their structure across hardware platforms, operating systems, and applications. To date, SGML has had the biggest impact on such massive documents as military contracts and aircraft manuals. But SGML will benefit PC-based

corporate documents of all sizes—from internal memos to budget reports to employee manuals. ("SGML: The Quiet Revolution," February 9, 1993, page 246.)

There are already products on the market that convert files from the top-selling PC word processors into SGML

files. At the high end of price and performance, there's Avalanche Development's FastTAG (303-449-5032) and Exoterica Corp.'s OmniMark (613-722-1700); and at the low end, there's Zandar Corp.'s TagWrite (802-899-1058). Windows users can already author SGML documents with SoftQuad's Author/Editor (416-239-4801). And by year's end, many of the major PC word processing

and desktop publishing houses will deliver SGML authoring tools and converters.

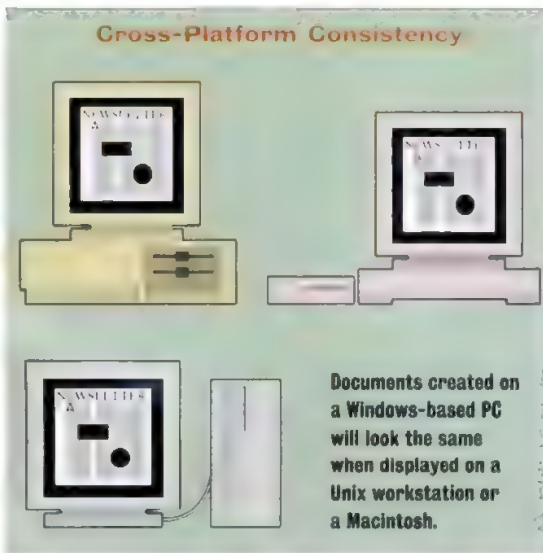
"SGML is key because it's the only standard for structured information that is open to interchange," says Moira Meehan, SGML product marketing manager at Interleaf. "It lets desktop publishers focus on the quality of information, and on its structure, content, and reusability." Interleaf expects to include SGML support in a product for Windows NT later this year.

Because SGML separates structure from content, "You can redefine the format without changing the content—and without recomposing the entire page," explains Bryan Standley, Ventura Software vice president. Today, Ventura users can buy InterMedia and the Instance Imager from US Lynx (212-673-3210) to convert their

Top Retail Software

Current ranking	Last issue	Product/company
1	1	TurboTax ChipSoft Inc.
2	5	Microsoft Access Microsoft Corp.
3	—	Paradox for Windows Borland International
4	4	Microsoft Windows 3.1 Microsoft Corp.
5	2	WordPerfect 5.2 for Windows WordPerfect Corp.
6	11	Stacker 3.0 Stac Electronics
7	10	WordPerfect 5.1 for Windows WordPerfect Corp.
8	8	Microsoft DOS 5.0 Upgrade Kit Microsoft Corp.
9	9	QEMM-386 6.0 Quarterdeck Office Systems
10	3	Quicken for Windows 2.0 Intuit
11	12	Microsoft Office for Windows 3.0 Microsoft Corp.
12	15	WordPerfect 5.2 for Windows Upgrade WordPerfect Corp.
13	7	Quicken 6.0 Intuit
14	—	Microsoft Excel 4.0 Microsoft Corp.
15	—	Procomm Plus 2.01 Datastorm Technologies

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending February 6, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.



documents into SGML files, and Ventura is considering adding an SGML authoring tool to Ventura Publisher.

Another advantage of SGML is that it lets you store tagged data in a central repository. "A law firm, for example, could use SGML to define standard contract clauses," explains Michael Cockrill, Microsoft Word program manager for SGML. Microsoft's multimedia group used SGML extensively for the data preparation of Encarta, its forthcoming multimedia encyclopedia. The company plans to deliver an SGML converter for Word for Windows soon after the next release.

"With the help of a hypertext retrieval engine, you can turn tagged SGML data into a full-text database," says James Mason, chair of the ISO working group on document description and processing languages. Novell, for example, recently began converting its product manuals into SGML-based documents using Electronic Book Technologies' DynaText engine (401-421-9551). NetWare 4.0 is Novell's first product to use the on-line documentation. Other PC-based SGML products expected later this year include ArborText's ADEPT Series, a set of SGML publishing tools currently available for Unix (313-996-3566); Frame Technology Corp.'s FrameBuilder, an extension of the FrameMaker product line; and WordPerfect Corp.'s IntelliTag, a WordPerfect add-on.

Once a company maps its existing style sheets to SGML tags, users can remain blissfully ignorant of SGML for the most part. Soon, you may be creating SGML documents without even knowing it.

—Mary Kathleen Flynn

Software and the PCMCIA Card

MODEMS MAY BE THE FIRST THING that comes to mind when you think of the PCMCIA slot, but software developers are beginning to distribute applications on PCMCIA cards.

Software on the credit card-size memory devices will make today's floppyless computers, such as Dell's 320SLi or Zenith Data System's ZLite, much easier to use. With their nanosecond delivery time, PCMCIA cards speed up the process of loading apps and data from desktop machines to these portables (a process that otherwise requires slower cables or modems). Another advantage to portable users is that PCMCIA cards have no moving

A DEMO IS ONE THING, BUT AN EVEN

better buying tool would let you play with the real application. TestDrive Corp. plans to offer a \$9.95 CD-ROM that contains approximately 100 applications, which you can try out a limited number of times. If you want to buy an app, you can install it immediately. TestDrive will register you as a user and send you the retail package (408-354-8055).

FLASH MEMORY—BASED HARD DISKS WILL

be more widely available by the end of the year. SunDisk, in conjunction with Seagate Technologies, is already selling hard disks based on its own flash memory. Conner Peripherals and Intel recently demonstrated a 2.5-inch drive that uses Intel flash memory chips instead of moving parts. Products should be out by year's end—assuming Intel solves its supply problems.

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peripheral *PC Magazine* considers more

parts, making them impervious to most weather and shock conditions.

Memory Card Associates seems to be furthest along in delivering applications on PCMCIA cards today (800-949-7256). The company offers over a dozen popular software titles on PCMCIA cards using either flash memory (for easy upgrades) or less expensive One-Time Programmable ROM chips. For the cost of the software and the PCMCIA card, the company provides users with Lotus 1-2-3, Quick- en, WordPerfect, and many other products. The company will transfer your software to the cards, and even test it for compatibility with Poqet PCs or other non-Intel machines.

Although the potential is there, it may still be a bit early for most mainstream applications to show up on PCMCIA cards. WordPerfect Corp. stopped offering WordPerfect 5.1 on PCMCIA cards because of the limited market.

Briefs

reliable than a Hewlett-Packard LaserJet. And yet HP has started selling a three-year support package. Nervous buyers may want to shell out 10 to 15 percent of the purchase price for the added reassurance of a next-day replacement, but we can't help thinking you'll probably never need it.

KNOWN FOR ITS EARLY ADOPTION OF THE

CD-ROM, Corel Corp. is now rallying behind the floptical disk, which provides 21MB of storage and compatability with 3.5-inch floppies. CorelDRAW will soon be preloaded onto Iomega floptical and removable disk drives.

TO FURTHER EVANGELIZE THE SGML

electronic publishing standard, several developers—including ArborText, Avalanche Development, Electronic Book Technologies, Interleaf, Oracle, and SoftQuad—have formed a consortium called SGML Open.

—Mary Kathleen Flynn

Corel Corp., an early CD-ROM evangelist, is still only considering publishing CorelDRAW on PCMCIA cards.

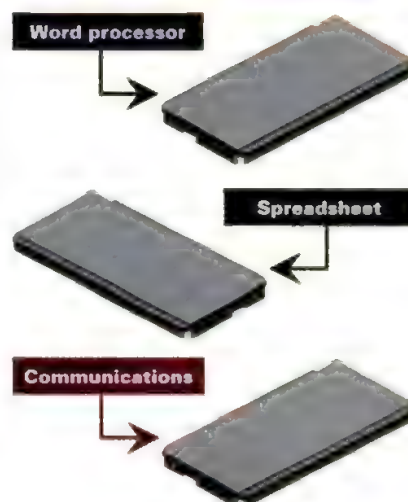
Perhaps what holds the most promise for PCMCIA-based software are upcoming personal digital assistants, such as Apple's Newton and General Magic's Personal Intelligent Communicator. Without a hard or floppy disk, PDAs will require PCMCIA cards for both applications and data. PDAs will be able to use PCMCIA's Execute In Place (XIP) capability to run software right from the card, rather than loading it into RAM.

Ultimately, XIP may make it so that

applications won't need system memory at all—they may get all they need from the cards they rode in on. Like Nintendo cartridges, application cards will truly be plug and play.

—Andrew Kantor

Apps Move to PCMCIA Card



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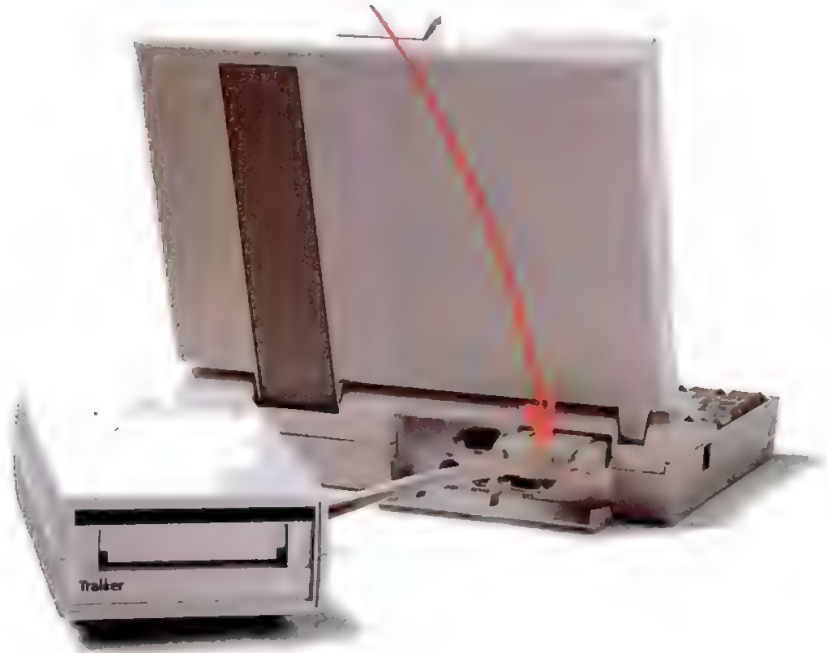
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CIRCLE 073 ON READER SERVICE CARD

First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

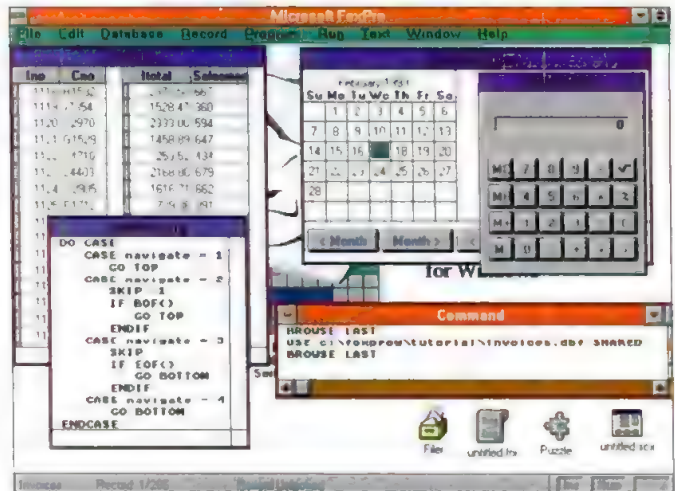
■ Databases

FoxPro 2.5 Thrives In Windows, Gets Even Faster in DOS

BY RICHARD HALE SHAW

Microsoft's latest offensive in the PC database wars is a two-front assault. Microsoft FoxPro, Version 2.5 for Windows, is an excellent graphical implementation of the long-admired database. And Microsoft FoxPro, Version 2.5 for MS-DOS (the long-awaited upgrade to FoxPro 2.0), is faster and slicker than ever.

Both programs show that Microsoft knew what it was doing when it acquired Fox Software last summer. Flaunting the vigor, breadth, and speed of a mature but still vital Xbase database, both flavors of FoxPro 2.5 are priced at \$495, the same as Microsoft's Access (First Looks, January 26, 1993). Both are compatible with FoxPro 2.0 (though libraries must be recompiled) and can run 2.0 ap-



WINDOWS DATABASE: FoxPro 2.5 for Windows is well integrated.

■ Special Report

Utility Vendors Find Big Market in Bettering DOS 6

BY CAROL LEVIN AND LANCE ULANOFF

This issue's cover story on MS-DOS 6 outlines all the utilities that Microsoft has crammed into the latest release of its flagship operating system. Do these utilities mean death for the vibrant DOS utility market? Not a chance. The major utility vendors are scrambling to provide new versions of their products that will augment or supplant the new features of DOS 6. Here's what's coming up. DOS 6's DoubleSpace disk

compressor is tightly integrated with the DOS 6 kernel and eliminates many of the problems that have long plagued disk compression programs. Because



DISCOVERY: A graphical look for NetRoom 3.

Microsoft has made the compression interface public, third-party products can also hook

applications without modification.

While the DOS version includes a 16-bit variant for those using older PCs, both packages

into the DOS kernel.

Stac Electronics is working on an unnamed compression product that will be tightly integrated with DOS 6, will convert DoubleSpace volumes to Stacker, and will offer disk recovery tools that automatically diagnose and fix disk problems. Stacker, \$49.95 introductory price; 800-522-7822.

SpaceManager for DOS and Windows, a new data-compression manager from Vertisoft Systems, will work exclusively with DoubleSpace. In fact, DoubleSpace is based on Vertisoft's DoubleDisk technology. Positioned as an add-on to DOS 6, it will include a compression optimizer, a graphical reporter, and a file exchange facility. SpaceManager, \$89.95; 800-466-5875.

NEW MEMORY MANAGERS

By all accounts, MemMaker favors ease-of-use over depth of

are now 32-bit, DPMI-compliant applications targeted at database power users ready to reap the rewards of running high-performance software on megabyte 386 and 486 PC systems. Both versions are multiuser right out of the box.

Both flavors of FoxPro 2.5 offer enhancements and improvements over 2.0. For in-

Continues on page 40

► IN FIRST LOOKS

Lotus Freelance Graphics for Windows 2.0	38
Pixar Typestry 1.1	44
Hotwin 3.0	46
Megahertz PCMCIA Notebook Data/	
Fax Modem	46
WinCIM	48
NEC MultiSync 5FGe	48
Panasonic CF-1000	49
WinSense 1.1	50
BusinessWorks Accounting for Windows 7.2	50
Intel LANdesk Manager 1.0	52
Toshiba TXM-3401E	54
DECpc 466d2 MT	54
CompuAdd 450SLC2	56
Personal Label Printer for Windows	56

■ Presentation Graphics

Freelance 2.0 Adds OLE, 24-bit Color, Multimedia

BY JAMES KARNEY

Presentation power for procrastinators might be the best slogan for Lotus Freelance Graphics for Windows, Release 2.0. Its designers have made ease of use a key factor; so much so that even if you only put together presentations twice a year, you'll be creating good-looking slides within minutes.

This \$495 package has all of the tools you need to produce complex graphics from a series of templates. While these templates, called SmartMasters, aren't new to Freelance Graphics for Windows, Release 2.0 improves on the original version

animation, and video; special text effects; and animated slide-show transitions.

Windows veterans will welcome the addition of 24-bit color, OLE client and server support, and an expanded set of import and export filters, including filters for Harvard Graphics and Microsoft Excel formats. The program still bundles Adobe Type Manager (albeit the outdated Version 2.02) and now works with any installed TrueType fonts.

NICE AND EASY

Almost anybody can produce a series of slides with a presentation package, but creating one that is attractive and uncluttered is another matter entirely. Freelance 2.0 approaches that problem in two ways.

SmartMasters offers a variety of coordinated slide templates with professional backgrounds and accents, with place holders for

the basic elements. Each set includes 11 templates for titles, bullet lists, charts, and other standard slide layouts. This takes care of basic design and helps you avoid the temptation to pack too much information into a single image or overwhelm the audience with your font collection. Visual galleries in the selection dialog boxes have been added to make it easy for you to preview SmartMasters and clip art im-

ages before selecting them.

To make formatting simple, each master slide has preset places for entering all of the appropriate elements. Clicking on a place holder (which may read something like "Click Here To Place Page Title") in the WYSIWYG window opens up a text entry box or other appropriate tool.

SmartIcons below the menu bar, and tool-boxes on the bottom, left, and right sides allow easy access to most of the program's advanced features and tools. The interface is so intuitive that for most routine tasks you'll never need

to open the manual or click on the help button. There is very little guesswork.

We created a series of simple slides with clip art and a scanned logo in about 15 minutes, without ever touching the menu bar and relying only on the lessons

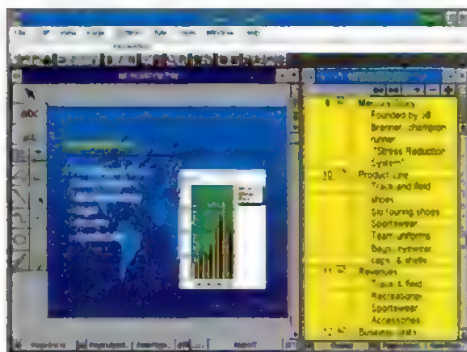
that are provided in the QuickStart tutorial.

CUSTOM DESIGNS

There's no need to feel hemmed in by SmartMasters. Freelance 2.0 has improved options for customizing presentations and fine tuning your design. There are two sets of rulers, one across



ORG CHART: Freelance 2.0 includes a wealth of drawing tools.



OUTLINE: Freelance 2.0 lets you build a presentation in outline style.

by adding 12 more designs, for a total of 65. While professional illustrators might find these preset options a bit confining, most users will find that they offer an almost painless way to complete a slick set of slides in a hurry.

Freelance 2.0 isn't a complete reworking of the software, but rather a fine-tuning of an already excellent program. It provides new tools for creating tables and organization charts; multimedia support for sound,

the top and side of the WYSIWYG work area and another on the top of text entry boxes. A new text-effect tool offers 27 ways to wrap text around a curve. While there is true-color support for imported objects, you will be limited to a 256-color palette for native Freelance 2.0 elements. You can control the contrast, brightness, and sharpness of bitmap images, and crop them for a good fit with the other elements in a slide. You can easily convert SmartMasters from a full-color to a black and white palette. This is a handy feature if you want black and white handouts for your audience. Just toggle a button on the bottom of the work area.

Buttons provide access to another pair of enhancements: organizational charts and tables. Just click on the appropriate control and select the desired template from a dialog box complete with previews. Then fill in the blanks from a template. You can edit and arrange the new element in both WYSIWYG and Outliner modes.

Users who include charts in their presentations will find 12 new styles, including 3-D Area,

Lotus Freelance Graphics for Windows, Release 2.0
Lotus Development Corp., 55
Cambridge Pkwy., Cambridge,
MA 02142; 800-343-5414, 617-
577-8500; fax, 617-253-9150

List price: \$395, network version, \$495, upgrade, \$150

Requires: 3MB RAM, 9MB hard disk space, Microsoft Windows 3.0 or later

In short: Freelance for Windows is the easiest major presentation package to learn and use, and it provides a host of powerful tools. Even novice users can create attractive (and consistent) slides in a few minutes with its expanded SmartMaster style guides and SmartIcons. Veterans will appreciate the addition of multimedia support, as well as new tools for creating tables and organization charts.

ON READER SERVICE CARD

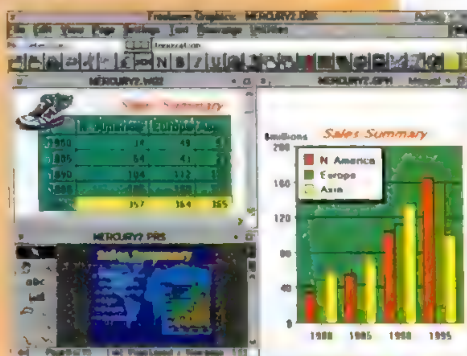
Freelance for OS/2 Arrives

Don't be mistaken. Lotus Freelance Graphics for OS/2, Release 2.0, may look like its Windows counterpart and may act very much like it (Freelance Graphics for OS/2 2.0 even costs the same), but underneath, they are two different programs. Feature for feature, the Windows version comes out ahead, but the OS/2 release has its own special advantages.

Both versions share a common user interface, including SmartMasters (there are fewer in the OS/2 version), SmartIcons, and SlideSorter and WYSIWYG modes. The OS/2 version doesn't have an Outliner mode and has a narrower range of chart types. Both versions provide drawing tools, fill-in-the-blank slide creation, and a ScreenShow module. However, support for multimedia sound, animation, and video clips is omitted from the current OS/2 release. Regular users of either version will have no problem shifting from one to the other.

On the plus side, the OS/2 release is a full 32-bit application and takes advantage of the OS/2 Workplace Shell. The result: multithreading, drag-and-drop file launching and printing, faster screen operation, and direct links to the rest of the Lotus OS/2 SmartSuite. That series currently includes only Lotus 1-2-3 and Freelance, but Ami Pro, CC:mail, and Notes are on the way.

Freelance for OS/2 isn't quite as full-featured as the Windows version is, but if you need (or prefer) to use OS/2 over Windows, then this is the presentation program of choice.—JK



32-BIT APP: Freelance for OS/2 has drag-and-drop file handling.

3-D Bar, and radar-style, bringing the total to 108 formats. Importing data for charts from spreadsheets and databases has been enhanced, too. The package has full OLE and DDE support, and we had no problems moving data and even complete charts from dBASE IV, Excel, and Lotus 1-2-3 into our presentations.

Focusing attention on parts of a chart or other objects is easy with Freelance 2.0's drawing tools. These include rectangles, circles, curves, lines, drop shadows, arrows, and a freehand tool. A 500-piece library of editable symbols and clip art can be used to decorate a slide, and

elements can be used to form bullets and pictographs in charts.

GETTING ORGANIZED

Freelance 2.0 offers three different ways to work with and view your presentation. The right side of the window has icons that let you change between single image, outline, and slide-sorter modes. One common complaint with the last release was with the weakness of its outliner. The new outliner has the ability to expand and collapse levels, the ability to do drag-and-drop editing, and the ability to use outline files created in Ami Pro, Microsoft

Word for Windows, or WordPerfect for Windows.

Since Freelance 2.0 uses a fill-in-the-blank metaphor, almost all of the work of creating a presentation can be done right in the outliner. We were able to transform an existing course outline created in Word for Windows into a series of 35 slides by just pasting it into the outliner, choosing a SmartMaster set, and fine tuning the layout. All of the text was in place when we shifted to the WYSIWYG mode to add charts and graphics.

The Slide Sorter mode shows thumbnails of all the images in a presentation. You can use it to re-order, delete, or add slides. Freelance 2.0 also lets you print handouts with up to six images per page, attach speaker's notes on-screen to rehearse your presentation, and print speaker's notes in a 3-by-5 notecard form for each page of the presentation.

When you're ready to convert your electronic presentation into 35mm slides, you can use the included comm software to send files over a modem to Autographix, a leading slide-creation bureau.

AN ANIMATED APPROACH

Freelance 2.0 can do double duty, both in preparing and in presenting your work. The SmartShow functions include 32 transitional effects—wipes, fades, curtains, and flying text.

A complaint: There aren't any scripting tools with Freelance, so there is no way to set how slow or fast an effect will operate.

If you have a multimedia-capable system, Freelance 2.0's presentation possibilities expand, letting you attach sound,

animations, or full-motion video. The program comes with sound files that you can integrate into your presentation for more impact. It supports .WAV and .MIDI files and Intel's DVI for video. With the help of Lotus Media Manager and Lotus Sound Recorder, multimedia objects can be set to run whenever a visual is shown on the screen, or only when a button is clicked. You can also use the mouse to draw a slide or to make annotations during a talk. A VCR-like control panel gives almost complete control over a presentation.

Another point in Freelance 2.0's favor is the program's ability to branch to different portions or versions of a presentation, rather than forcing you to follow a fixed order. This can be a very handy feature if you have to prepare similar graphics for different audiences. There is no run-time version of Freelance available, so if you plan to run a presentation on another machine, a copy of the program must be available on that machine as well.

Lotus Freelance Graphics for Windows, Release 2.0, may not offer all the tools that a professional illustrator wants, and some may find the fill-in-the-blank approach a bit stilted, but anyone who sees the task of preparing a presentation as a chore rather than a regular job will en-



SMART ICONS: Like all Lotus products, Freelance 2.0 includes customizable icons.

joy all the attention to detail that has gone into the latest release of this presentation powerhouse. □

First Looks

FoxPro 2.5

CONTINUED FROM PAGE 37

stance, FoxPro 2.5 provides users and applications with 225 work areas (FoxPro 2.0 limits you to 25), and there's no limit to the number of table relations. The APPEND FROM command now reads Excel 3.0 and 4.0 worksheets, as well as Paradox 3.5 and 4.0 tables. And FoxPro's flavor of the Xbase language now includes compilation controls—#define, #undef, #if, and #endif—similar to those found in C.

But the big news is FoxPro 2.5 for Windows. A superset of the DOS product, the Windows version comes across as a more elegant version of FoxPro 2.0 for DOS. Everything is where you'd expect it, and all the familiar windows, menus and commands are in place. There are only two types of differences: those where a feature (such as color selection) is already provided by Windows and thus isn't required by FoxPro, and those where FoxPro 2.5 for Windows takes explicit advantage of the Windows GUI.

FACT FILE

Microsoft FoxPro, Version 2.5 for MS-DOS; Microsoft FoxPro, Version 2.5 for Windows

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329

List price: \$495; Multiuser License Pak, \$425 per workstation.

Requires: DOS version, 640K RAM, 5.6MB hard disk space, DOS 3.1 or later; Windows version, 4MB RAM, 3.7MB hard disk space, Windows 3.0 or later.

In short: A fast, powerful Xbase database for DOS and Windows. While both versions offer 32-bit DPML and improvements over previous versions, the Windows version has DDE and OLE support and integrated graphics.

ON READER SERVICE CARD

Performance Tests: FoxPro 2.5

Both FoxPro 2.5 for MS-DOS, and FoxPro 2.5 for Windows, proved significantly faster than FoxPro 2.0 or the Paradox counterparts, Paradox 4.0 for DOS and Paradox for Windows. But the real news is that a Windows-based database is now outperforming a leading DOS-based product.

The Select tests, in which the scores diverged by a factor of more than 4, stand out. In the Join test, the differences were not as striking. In fact, the differences between the results of Paradox for DOS and both FoxPro 2.5 scores were barely measurable.

Lower scores represent better performance.

Seconds	Load	Index	Select (numeric)	Select (alphanumeric)	Join
FoxPro, Version 2.5 for MS-DOS	988	554	<1	4	<1
FoxPro, Version 2.5 for Windows	1,166	962	<1	6	<1
FoxPro, Version 2.0	1,634	680	<1	11	2
Paradox 4.0 for DOS	5,507	1,913	5	27	1
Paradox for Windows	7,398	1,376	8	29	3

We evaluated the performance of FoxPro 2.5 for DOS and Windows by running a series of tests interactively, using the native file formats of the respective programs. We ran all tests on a Compaq Deskpro 386/25M equipped with 8MB of RAM.

The Load and Index tests measure the time it takes to import four 100,000-row tables from an ASCII file and to create 13 indexes.

The Select tests measure the time it takes to search indexed numeric and alphanumeric fields in a table, returning 10 percent of the table as a result.

The Join test measures the time it takes to perform a join on three numeric primary-key fields.

PERFORMANCE

What about performance? PC Labs found that both FoxPro 2.5 versions are faster than the DOS-based FoxPro 2.0, except that FoxPro for Windows 2.5 took more than 40 percent longer than FoxPro 2.0 to build an index. The Windows version took 18 to 73 percent longer than its DOS counterpart to complete individual tests, but when compared with the competition, this hardly seems to matter: In three out of five tests, both versions of FoxPro 2.5 continue to run more than four times as fast as either Paradox 4.0 or Paradox for Windows; only in the Join and Index tests were they relatively close.

FoxPro for Windows extends FoxPro's query-by-example (QBE) facility by letting you direct the result of a query to a graph (in 2.5 for DOS, you can send them to FoxGraph). Graphs are created via GraphWizard—a feature identical to the Wizards in Microsoft Access and Excel that walks you through the steps

required to produce and print a graph.

You can use graphs in reports or store them in the new GENERAL field type in a database table. Open a browse window on the graph database and double-click on the field, and FoxPro will display the graph. Double-click on the graph and FoxPro, an OLE (Object Linking and Embedding) client, will

DDE client or server and exchange data over a network via Network DDE.

The Screen Builder and Report Writer in the 2.5 DOS version are essentially the same as those found in FoxPro 2.0. But in FoxPro for Windows, both of these tools offer more features and functionality, including a toolbox for accessing design tools and objects (fields, bitmaps, labels, rectangles and lines), as well as fill colors, pen colors, and fill patterns.

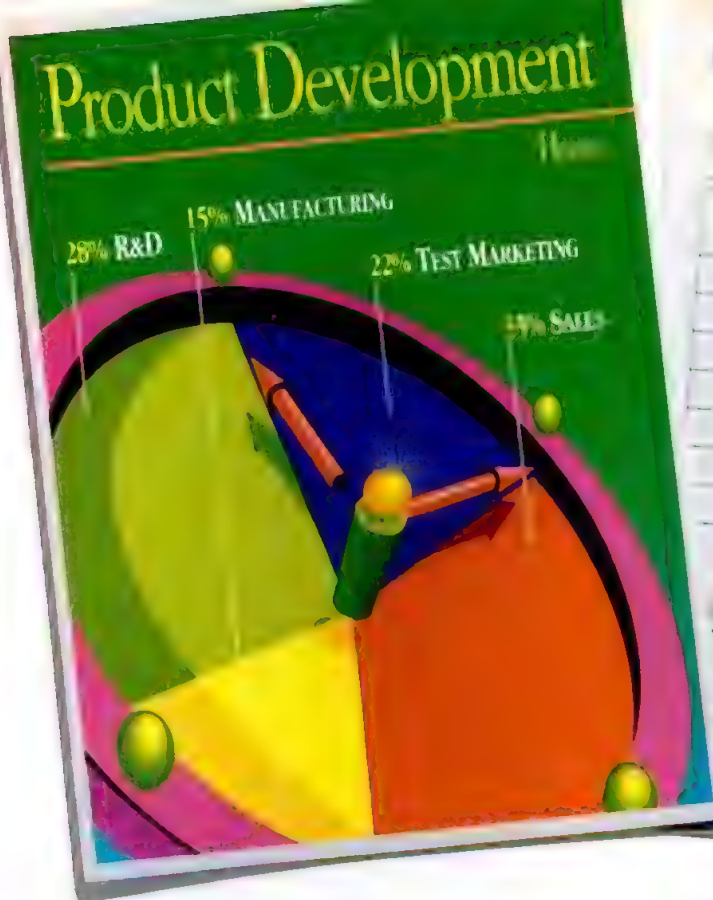
The Screen Builder in the Windows product also features alignment tools; the ability to use bitmaps as wallpaper in any screen, window, dialog, or button; an Object Order dialog for controlling tabbing order in a window; and a Screen Layout dialog for previewing the screen and selecting window attributes and a minimize icon.

FoxPro for Windows has a spell checker that uses the same spell-checking dynamic link library that Excel and PowerPoint use. The spell checker can be invoked while



APP BUILDER: You can create graphical applications using all the standard Windows controls.

invoke Microsoft Graph (included in the package) to edit the graph. Via OLE, you can add sound, pictures, and spreadsheets created by other Windows applications to FoxPro applications. You can display OLE



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✓ laser paper
✓ 2pp/min
✓ Adobe PS Level 2

APPROVED

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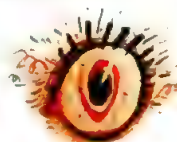
X

Our new color printer not only looks great on paper, it looks great on paper.

True, the brilliant color produced by the new Tektronix Phaser® 200 is captivating. But the price is equally attractive. And though we've become the award-winning leader in color printers by frequently outdoing the competition, this time we've even outdone ourselves. Introducing our newest business work group color printer.



The eye when it sees black and white.



The eye when it sees color.

The Phaser 200 is compatible with virtually any business software and can print two colorful pages per minute. No, not two minutes per page—two pages per minute. And even at a speed like that, it still manages to print eye-catching color on common laser paper or transparencies using a separate input tray for each. You select the medium you want at your computer keyboard. And it switches automatically from user to user just as easily, using its parallel, serial, AppleTalk™, or optional EtherTalk™ and Ethernet™ ports.

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CIRCLE 001 ON READER SERVICE CARD

First Looks

editing a memo field, a text file, or even a program.

CROSS-PLATFORM TRANSPORTER

The most revolutionary feature of FoxPro 2.5 is the Cross-Platform Transporter, which lets you create and maintain applications on one platform (such as MS-DOS) and run them on another (such as Windows). The Transporter provides three strategies for porting reports and screens. First, you can run an application without modification: FoxPro for Windows will use mono-spaced fonts, one-line-high controls, and half-height title bars to imitate the look of a FoxPro for DOS application.

Second, you can transport an application to use a few, platform-specific features: You'll have the option of selecting fonts, but the Transporter will automatically modify each screen object to run under Windows. Finally, you can modify the application itself further to use Windows-specific features such as bitmaps, wallpaper, icons, and OLE objects.

In all but the first case, FoxPro adds to the application components to contain platform-specific information that's used when you run the application under Windows but is ignored when you run it under DOS. Thus, if you run the application under DOS again, the application will not appear to have changed.

While it uses the same calling interface as the 2.0 version's Library Construction Kit, FoxPro 2.5 for Windows uses Windows DLLs (dynamic link libraries) in place of library files. Once your code is executing in a DLL, it can call any other Windows DLL—including those that are used by other applications or are a part of Windows itself.

With upgrades from competitive products for \$199 and from old versions of FoxPro for as little as \$99, there's no reason why the dedicated Xbase user or developer shouldn't be using these products. □

DOS 6

CONTINUED FROM PAGE 37

features. By the looks of the following new products, memory management is still good business for developers (see "Pipeline," page 30).

Helix Software's new NetRoom 3 utility will use its own proprietary "cloaking" technology to stash pointers to its own 32-bit BIOS and video BIOS—all loaded in XMS to an 8K box of conventional

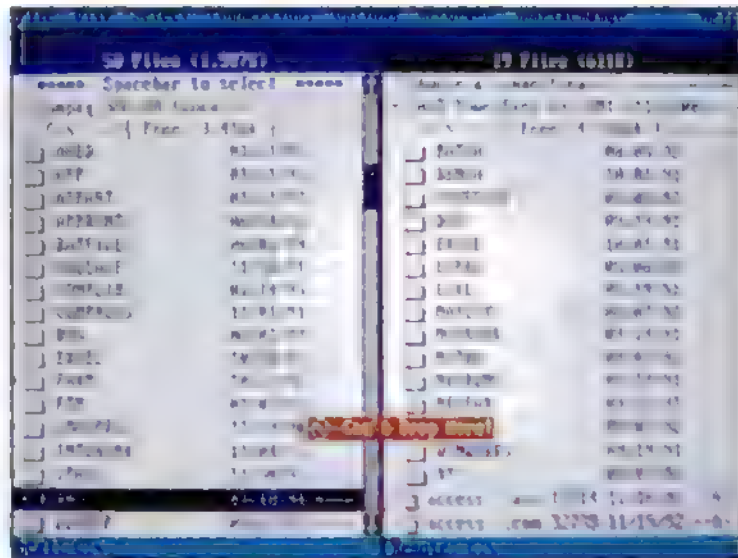
memory. It will load the EMS page frame, a fast 32-bit disk cache, and screen saver in extended memory. Each copy will come with Helix's Cloaking API, which will enable developers to build applications that use virtually no conventional memory. Helix is also putting a new interface on Discover, its system analysis tool. NetRoom 3, \$99; 800-451-0551.

Qualitas doesn't plan to drop the soon-to-be outdated "386" moniker, but it does have a new version in the wings. 386MAX, Version 7.0, will create a SuperDOS Window that gives DOS applications running under Windows up to 736K of conventional memory. It will also have a PIF editor with helpful memory configuration hints, and will provide memory management on systems running DOS 6's finicky multiboot feature. Version 7.0 will optimize memory on drives compressed by DoubleSpace, Stacker, or SuperStor; relocate FILES, BUFFERS, COMMAND.COM, and more into high DOS; and determine the optimal amount of UMB space required for Windows. 386MAX, Version 7.0, \$99.95; 800-676-6386.

FILE TRANSFER

If you're a two-PC person, you probably rely on LapLink to

transfer files over a cable or modem. For you, DOS 6's InterLink file-transfer utility may be a step back. You'll be happy to hear that Traveling Software has made two significant improvements to LapLink.



LAPLINK: Drag and drop three ways.

First, though still a DOS program, LapLink V has a more graphical look and feel, so you can drag a file name from a host to a client window. But the big news is that peer-to-peer file transfer occurs over NetWare—at speeds of up to 8MB per minute. LapLink V, \$169.95, upgrade \$49.95; Lap-Link V for NetWare, \$99.95; 800-343-8080.

BACKUP

For the heavy-duty backup jobs that fall on the shoulders of network administrators, Microsoft Backup—a subset of Symantec's The Norton Backup—is out of the running. The shortcomings of Backup for MS-DOS and Backup for Windows are four-fold: no high-speed DMA (direct memory access) to floppy disk, no tape backup, weak password protection, and no unattended, scheduled backup.

Symantec's own full-fledged The Norton Backup 3.0 for Windows and The Norton Backup 2.2 will offer all of the above, as well as DoubleSpace-compatible Norton Disk Doctor exams and network features

such as backup and restoration of all NetWare bindery information and extended file attributes. The Norton Backup 3.0 for Windows, The Norton Backup 2.2 for DOS, \$149; upgrade, \$39; 800-441-7234.

VIRUS PREVENTION

DOS 6's virus protection utility is actually a subset of Central Point Software's popular anti-virus product. In addition to its reliance on Central Point for virus signature scanner upgrades, Microsoft Anti-Virus lacks such network features as customizable warning messages and log-on protection. The new Norton AntiVirus 3.0 for DOS/Windows should be faster, more customizable, and more network-aware than DOS 6. The Norton AntiVirus 3.0 for DOS and Windows, \$129; 800-441-7234.

ALL-IN-ONE UTILITIES

Other than the basic diagnostics in MSD, the doctor's bag in

DOS 6 is empty. When disaster strikes, you'll need a third-party package. The Norton Disk Doctor in The Norton Utilities 7.0 will be able to recover data from damaged files compressed with DOS 6's DoubleSpace, though some problems, such as lost clusters, can still be fixed with DOS 6's new DoubleSpace-aware CHKDSK. Norton accomplishes this by supporting MRCI (Microsoft Real-Time Compression Interface). It will also include a new Speed

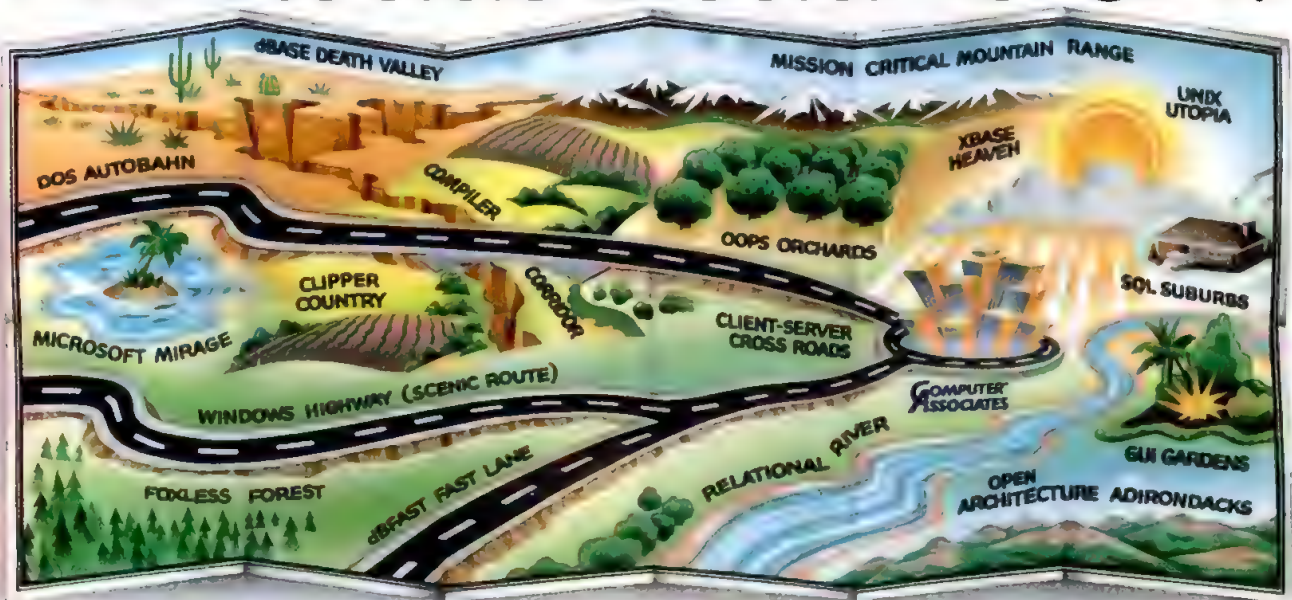
Disk utility for optimal defragmentation of DoubleSpace volumes, and a hardware diagnostics program. The Norton Utilities 7.0, \$179; upgrade, \$49; 310-449-4140.

Finally, Central Point will offer a compatibility release of PC Tools, Version 8.0a, that will defragment and repair files on DoubleSpace disks. □



From March 29 to April 2 you can go on-line on PC MagNet to discuss the future of DOS utility software with PC Magazine editors and representatives from Symantec and other vendors. Type GO ZNT:EXEC from any CompuServe prompt.

For Xbase All Roads Lead To CA.



It's been a very difficult and confusing couple of years for Xbase developers. Filled with uncertainty and doubt about the future. At times, some questioned whether Xbase even had a future.

But those days are over.

With the resources, experience and support of the world's leading database company behind it, and with the combined technological wealth of CA-Clipper®, CA-dBFast™ and Computer Associates, the future of Xbase has never looked brighter.

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To build the Xbase system of the future, we've added CA's visual tool and client-server technology to Nantucket's next generation Xbase project. This new system will provide a fully object-oriented Xbase language, native code compiler, an IDE (Integrated Development Environment) and both DBF-style and client-server database support.

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There are two migration paths to this ultimate Xbase system: The OOP (Object-Oriented Programming) path of CA-Clipper and the GUI (Graphical User Interface) path of CA-dBFast with Windows support.

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copy today. And find out why the future of Xbase will lead you right to CA.

To get the complete story on The Future Of Xbase, call for this special 30-page statement of direction. It contains an Executive Summary as well as an in-depth discussion of Xbase in the 90s, CA's Open and Client-Server Architectures, Integrated Development Environment, Xbase migration plans and end-user tools.

Call for your



CA-dBFast for Windows and CA-Clipper 5.01 for DOS received honorable mentions for Best Database Manager

COMPUTER ASSOCIATES
Software superior by design.

■ Graphics Software

Pixar's Typestry: PC Type Enters the Fourth Dimension

BY LORI GRUNIN

Anyone whose boring presentation has put an audience to sleep will love Pixar Typestry, a \$299 Windows-based utility that lets you quickly and easily create polished, animated 3-D text sequences. Typestry lets you take any TrueType or Type 1 font, extrude it, render it using Pixar's renowned RenderMan photo-realistic rendering software, and generate a simple keyframe-based animation.

In addition to a toolbar that contains the text, move, rotate, scale, and perspective tools, Typestry's interface consists of tear-off dialog boxes for controlling lights, rendering status, and "looks"—Pixar's term for its procedural shaders, the algorithms that generate its photo-realistic special effects.

You enter text into a dialog box that also allows you to set the typeface, bevel depth, and one of four bevel styles. Although Typestry can work only with type elements—you can't even bring graphics in via the clipboard—you can add basic shapes such as squares, tri-

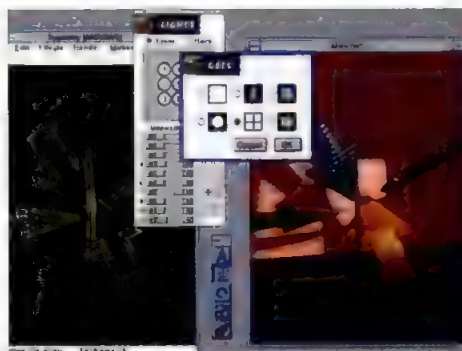
angles, and arrows by exercising a little creativity with dingbat characters.

Once you've built your text object, you can assign one of the 24 looks that ship with the product to the entire object or to the individual characters; the side faces of the characters can use a different look than the front and back as well. Typestry allows you to specify the opacity, and in some cases the color, of the look. In addition, you can specify the angle, location, and look of a floor and a wall to serve as a background.

Four rendering options—Quick'n'Dirty, Reasonable, Excellent'n'Slow, and Custom—combined with an optional crop window for specifying an area to render, let you optimize rendering time for draft previews. Rendering speed is surprisingly fast, especially for a Windows product, and on the local-bus 66-MHz 486 we used for testing, it was downright tolerable: It took about an hour to render a 26 frame .FLC file to disk.

Pixar Typestry includes a look that lets you generate .TGA or similarly formatted

files that support a fourth channel (in addition to red, green, and blue). Other supported output formats for rendering an individual frame include .BMP, PostScript, TIFF, and the



SHINE A LIGHT: Gels let you simulate light shining through an object, such as a window.

RenderMan .RIB file format.

Pixar will soon be releasing a Windows version of its Glimpse utility (\$150), which lets you edit and generate new looks. Several of the included looks come from The Valis Group (Point Richmond, California; 510-236-4124), from which you can obtain new ones.

Typestry's straightforward controls give you adequate control over lighting: In addition to dictating the level and color of the ambient light, you can specify the placement of each of 18 individual light sources (front and back), the distance of the light from the objects, the light color, the gel (filter) through which the light shines, the focal point of the light, and whether or not the source casts a shadow.

Basic special effects include viewing the scene through a fisheye or telephoto lens and adding a motion blur or a motion blur with a trail. The text object can be built up or carved out of the selected material, or you can apply perforations—

shapes carved out of the object.

Typestry's keyframe animator doesn't offer a lot of flexibility, but animating the text is exceptionally easy and serves as an excellent introduction for those new to frame-based animation. At its most basic, you simply add a keyframe and place the objects into position; the program calculates all of the frames in between. When the work is complete, Typestry can render the animation in the Animator Pro .FLC format—the product

ships with a copy of the Autodesk Animation Player for Windows—or render individual frames into sequential files. Typestry's handling of its 256-color palette is unspectacular, so you may be unimpressed with the .FLC results.

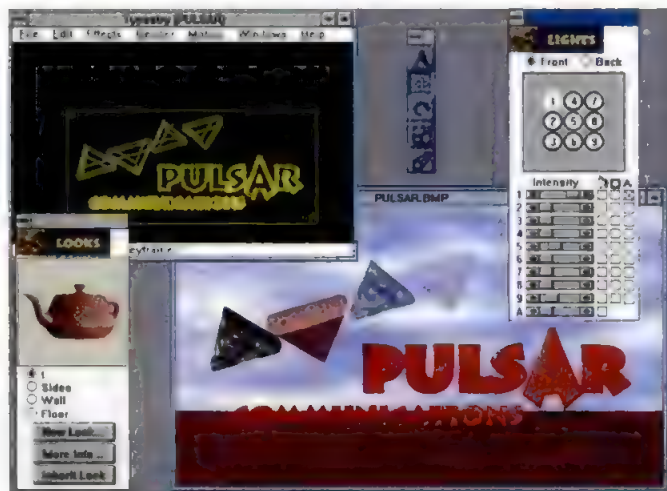
While you can certainly do

quite a bit with Typestry—even with its limitations it produces the most attractive rendered output of any PC-based package under \$2,000—it does have its inflexibilities. The only parameters that you can change over time are size, position, and orientation of objects; for instance, you can't change lights (although a light source can track an object's movement), looks, or opacity without resorting to workarounds.

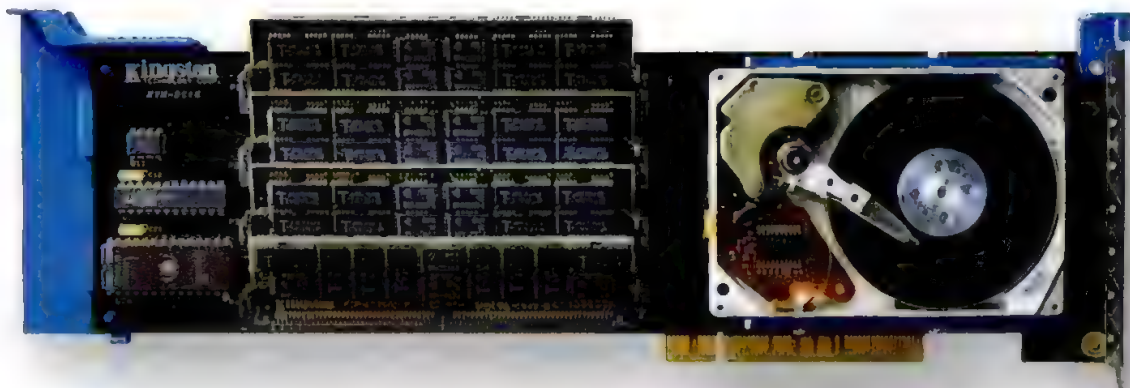
Regardless, Typestry offers an effective way to add some life to the flat, lifeless logos and text that may currently reside in your electronic presentations, or it will simply increase your PC's fun quotient.

• **List price:** Pixar Typestry, Version 1.1, \$299. **Requires:** 4MB RAM (8MB recommended), 5MB hard disk space, Microsoft Windows 3.0 or later, (24-bit color recommended). Pixar, 1001 W. Cutting, Richmond, CA 94804; 800-888-9856, 510-236-4000; fax, 510-236-0388.

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GET THE LOOK: Typestry lets you apply surfaces to each object.



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CIRCLE 106 ON READER SERVICE CARD

Windows Utilities

Hotwin 3.0 Drives Windows From Menu or Hotkeys

BY EDWARD MENDELSON

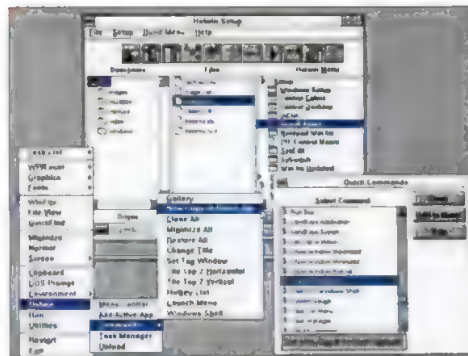
Among dozens of Microsoft Windows application launchers, menu programs, and desktop replacements, TMA Software's \$59 Hotwin, Version 3.0, may be the most powerful, subtle, and efficient of all. Hotwin helps you do virtually anything you want to do in Windows, without wasting screen space and with an absolute minimum of keystrokes, and you get exceptionally pre-

cise control over every detail of its operation.

The heart of the Hotwin utility is a compact, cascading menu that, on initial installation, matches the setup of your Program Manager groups. You can then add menu items with commands that, among other things, enable the screen saver, change the active window's title, minimize all applications, restart Windows, and switch among nine "virtual" screens that ex-

pand your desktop.

Hotwin lets you add currently running applications to the menu with a keystroke, assign sound files and icons to any application, and make the program remember the size and position of any application between launchings. You can decide whether a menu will launch a program a second time if the program is already running, or whether the running program jumps to the top. A unique "direct menu ac-



CUSTOMIZE: Hotwin has a detailed setup menu.

Modem Preview

No More Dongles: Megahertz Shows Sleek PCMCIA Modem

BY ANGELA GUNN

It just couldn't be any cuter. The \$599 Megahertz PCMCIA Notebook Data/Fax Modem has the credit-card shape that's common to all PCMCIA accessories. But this modem is unique for what it doesn't have: an unwieldy phone connector.

Instead, the XJACK, a stripped-down RJ-11 port, pops directly out of the card like a ballpoint pops out of a pen. The prerelease unit we looked at is the first sensible solution to the PCMCIA size limitation.

A PCMCIA 2.0e-compatible model, the Megahertz offers 14.4-kilobits-per-second speeds for both send/receive fax and data transmission, as well as V.42 and MNP-4 error correction and V.42bis and MNP-5 data compression. (A 2,400-/9,600-bps version is also available.) We experienced few problems with the Megahertz in preview testing. The problems we did find may be ascribable to the standard software.

On first glance, the plastic-

and-metal case seems somewhat fragile. The port, when extended, appears to be dangerously unprotected. But under normal usage, we found the port to be sturdy—we were unable to break it off. The modem does, however, get remarkably warm when in the PCMCIA slot, since it lacks any cooling system. We also found it easy to chip the corners of the modem case.

The Megahertz comes with a special version of MTEZ and Eclipse for Windows communications software. Installation of one program on the disk is necessary to initialize the PCMCIA port, but the modem does work with other packages when installed as a Hayes Ultra 14.4-Kbps modem.

We experienced some difficulties with MTEZ. We were unable to read faxes received via the FaxMan utility, and, at

startup, the package occasionally forgot the proper port setting for the modem. Additionally, ZModem support for MTEZ is available only as an add-on from WordPerfect. We were also unable to turn off the modem speaker.

Despite these minor annoyances, this modem represents a vast improvement over previous attempts at PCMCIA modem design.



POP-OUT: The data line plugs into the XJACK.

- List price: Megahertz PCMCIA Notebook Data/Fax Modem, \$599; 2,400-/9,600-bps version, \$379. Megahertz Corp., 4505 S. Wasatch Blvd., Salt Lake City, UT 84124; 800-527-8677, 801-272-6000; fax, 801-272-6077.

Circle 430 on reader service card

cess" feature lets you add commands to Hotwin's menu that jump to any menu item in any Windows program in one step.

Everything on Hotwin's menu can be assigned to a hotkey or to a combination of mouse clicks, and Hotwin even lets you use its hotkeys in full-screen DOS applications. You can use any of the program's ten toolbar icons for built-in functions such as finding or viewing files, or to access the feature that lets you remap the keyboard for single applications or throughout the system.

Hotwin's menu can include a run dialog box that lets you specify both a command line and a working directory, and it remembers 20 earlier commands. An optional replacement for the Windows task manager includes drag-and-drop controls, and allows you to hide applications.

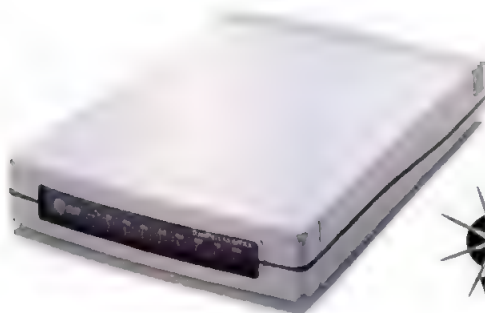
Hotwin can automatically reduce Program Manager or any other program to an icon when you run an application, and can then restore the program when the application closes.

Hotwin's functions overlap most closely with the hDC Power Launcher, but Hotwin is smaller, less obtrusive, and more manageable.

- List price: Hotwin, Version 3.0, \$59. Requires: 2MB RAM, Microsoft Windows 3.1. TMA Software, 520 Washington St., #148, Marina Del Rey, CA 90292; 800-497-3617, 310-822-6584.

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MORE SPEED: Only AT&T's exclusive Optical Line Interface (OLI), pat. pending, eliminates the noise that other high-speed fax modems add to the data stream. Less noise means you get the highest speeds possible on good or bad phone lines!

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Solidly-built, solidly-backed by AT&T.

\$299

Reg. price, \$555.
External for PC/AT/XT

\$289

Reg. price, \$505.
Internal PC AT-bus card

Comes complete with QuickLink II comm/fax software for DOS and Windows, CompuServe bonus (\$22.95 value), user's manual, fax modem phone cord. Mac version available, with Mac cable, reg. price, \$585 **now \$299.**

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Prices under \$300 vary by dealer, while supplies last. Hurry!



■ On-Line Communications

WinCIM: Even CompuServe Can Go Graphical

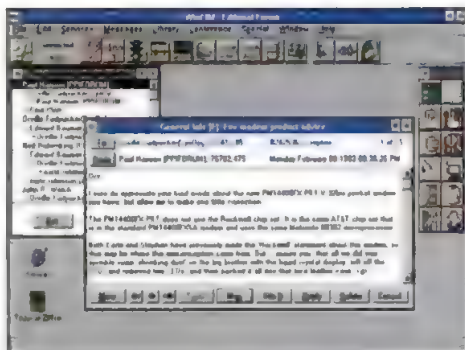
BY RICK AYRE

CompuServe, one of the world's largest on-line information services, features e-mail, libraries of files you can download, and public forums in which on-line

debates take place and technical advice is given. It's also the home of ZiffNet, where you'll find PC MagNet Computer Database Plus and other services.

But CompuServe has a big problem. It contains so much information that

finding it is nearly impossible for all but the most seasoned veterans. The on-line service sorely needs a better-looking, friendlier interface. CompuServe's first solution was the CompuServe Information Man-



WINCIM: Easier navigation through Forums.

■ Monitors

NEC Adds New 17-Inch MultiSync, Overhauls Others

BY JOHN R. QUAIN

Fortifying its already strong position in the monitor marketplace, NEC Technologies has expanded its line of MultiSync monitors. Since extending support for higher resolutions on the 15-inch 3FGx and 4FG models, the company has rechristened them the 3FGe and 4FGe. For GUI users looking for a larger screen, the company has added a new 17-inch monitor, the \$1,155 5FGe.

If you liked the 3FGx and the 4FG, you'll like these, too. The estimated selling prices haven't changed—\$635 and \$755, respectively—and the new models have the same chassis, the same flat-square antistatic polished screens, the same Invar shadow masks and 0.28-mm dot pitch. Users who find the polished screens too reflective can purchase optional lenses

with dark or light tints for \$70.

What has changed on the 3FGe and 4FGe are the vertical refresh rates and graphics mode support. The earlier model 3FG's two horizontal frequency ranges have been broadened slightly on the 3FGe from 31.5 to 38.5 kHz to 31 to 39.5 kHz, and from 47.8 to 49 kHz to 47.8 to 49.5 kHz. This brings the monitor's vertical refresh rates in VGA and SVGA up from 72 Hz to a more eye-pleasing 76 Hz. Maximum resolution still peaks at 60 Hz in noninterlaced 1,024-by-768 mode.

The 4FGe can now deliver a 76-Hz vertical refresh rate in noninterlaced VGA, SVGA, and 1,024-by-768 modes as well.

The 17-inch 5FGe is a larger version of the 4FGe, minus the color controls. It has all the same supported video modes and other controls as the 4FGe and is \$200 less than the 17-inch

ager for DOS, and now there's WinCIM for Windows users.

Since it's hard to know where you want to go and how to get there, WinCIM provides a combination of text and cute icons. It makes navigation easier by storing oft-used navigation commands (GO words), and by giving you point-and-click access to commonly used services like e-mail. WinCIM also takes advantage of cut-and-paste and other Windows features.

Some people access CompuServe in batch mode: a communications program script does all of your on-line processing at one time; you deal with the results later, off-line.

That's not the WinCIM way. It connects to CompuServe for you and does what you tell it to do; for instance, it will present a list of your new e-mail messages and let you respond interactively and on-line. Working off-line in batch mode may be

cheaper, but more complex.

WinCIM is great for CompuServe novices, as well as the on-line expert who wants to do some specific things, such as look for a file or search for one particular message. It's a great tool for exploring CompuServe, as long as you remember that exploring takes time—and on CompuServe, time is money.

WinCIM can be downloaded from CompuServe (type GO CIS:WNCIM from CompuServe or ZiffNet prompt).

• List price: *CompuServe Information Manager for Windows (WinCIM)*, \$10 plus download time (in return you get a \$10 usage credit); \$25 through the mail (in return you get a \$25 usage credit); documentation, \$10. *CompuServe Inc.*, P.O. Box 20212, 5000 Arlington Centre Blvd., Columbus, OH 43220; 800-848-8199, 614-457-0802; fax, 614-457-0348.

Circle 426 on reader service card

Professional MultiSync 5FG. However, besides the AccuColor controls, you give up the 5FG's 1,280-by-1,024 noninterlaced mode, its wider 135-MHz bandwidth, and its back-panel Mac and BNC inputs.

In tests with an early sample of the 5FGe, SVGA images looked crisp and sharp. In Windows, a crowded screen of text showed no transient response problems or color bleeding.

In subjective tests, one-pixel-wide lines proved sharp and clear with good convergence, even in the corners.

Displaymate's video torture test revealed virtually no blooming, barrel distortion, or moire patterns.

All of the new models support XGA and XGA-2 modes, comply with the MPR II low-emissions standard, and include three-year warranties.

• List price: *MultiSync 3FGe*, \$635; *MultiSync 4FGe*, \$755; *MultiSync 5FGe*, \$1,155. *NEC Technologies Inc.*, 1255 Michael Dr., Wood Dale, IL 60191; 800-388-888, 508-264-8000; fax, 800-366-0476.

Circle 431 on reader service card



NEW MODELS: The \$755 4FGe and the \$1,155 5FGe.

We're Playing Your Song!

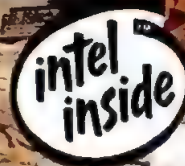
Gateway 2000's Greatest Hits

1. Gimme the Good Stuff
by Hammer and the Boys
2. Baby, Let Me Baby You
by The Support Group
3. We Got the Goods
by The Systematics
4. Megahertz So Good
by Pup and the Cells

5. So You Wanna Fly?
by The Screamin' Vs
6. Big Bandwidth Boogie
by The Gates
7. Software Improv
by Good Vibes
8. More Jazz Extrax
by The Cool Cats &



Coca



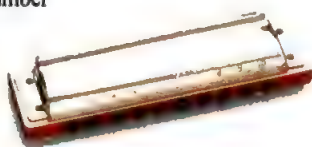
If Gateway 2000 was a record, what would we sound like? Music to your ears!

Those Old-Time Country Values *by The Low Overheads*

Our album would kick off with some great Country tunes because, after all, we're the original country PC company with the low-overhead prices. We're located

Country

in the heartland of America where our factory is bordered by corn and bean fields. KSUX country radio, the Super Pig, is the number one station in these parts (no fooling). Gateway folks are mostly midwest born and raised, and it shows in our quality workmanship and in the friendly, down-home way we treat our customers. We'll bend over backwards to please you. When you buy from Gateway, you get the best price, quality and service. That's a value nobody can beat.



Gimme the Good Stuff – *by Hammer and the Boys*

This song is dedicated to everybody who's tired of new technology becoming affordable only after it's upstaged by something better. At Gateway, we offer the latest, newfangled technology at homespun prices.

Baby, Let Me Baby You *by The Support Group*

Every Gateway 2000 system comes with excellent after-the-sale support. You get a **30-day money-back guarantee**. If you don't like your system, send it back within 30 days for a refund. All systems come with a **one-year limited warranty** and telephone **technical support** for the life of the system from our award-winning tech department. We received *PC World's* World Class Award in 1992 for best service and support in the hardware category. And in a February 1993 survey, *PC Magazine* readers once again gave Gateway an excellent rating for service and reliability. You also get a **lifetime BBS membership** for additional technical support and online forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). **Replacement parts** leave our factory as quickly as possible; we pay overnight shipping. Plus we now have **interactive documentation** on desktop systems with pictures and text right on your hard drive (in addition to comprehensive hardware and software manuals).

We make it easy for you to buy a Gateway PC, too, with convenient payment options including major credit cards and C.O.D. terms. Net 30-day terms and leasing options are also available to qualified commercial customers. All this *and* your great-looking Gateway PC comes in our distinctive, country cow-spotted box!



To serve you better, we've hired and trained over 500 new people for customer service, technical support, sales and manufacturing in the past five months, bringing our total number of employees to over 1,900.



◀ Gateway's 4SX-33 makes a mighty-fine Windows machine!

 **GATEWAY2000**

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ROCK

intel
inside

We Got the Goods – by The Systematics

Gateway's album would continue with some heart-pounding rock 'n roll cuts because our systems are definitely pure rock. They're cool-looking, hot-performing, high-energy machines – at some sweet prices. There's a model that's perfect for you.



Megahertz So Good – by Pup and the Cells

Gateway's mini-desktop systems – 3SX-33, 4SX-33 and 4DX-33 – are petite but plenty powerful, based on a integrated design that incorporates many subsystems on the motherboard for the best price-performance ratio. All mini desktop systems include: 4 to 8MB RAM; a large and fast hard drive, operating on the local bus in 486 models for even faster drive performance; a fast video chipset with 1MB; a brilliant, crisp display from the standard 14-inch CrystalScan non-interlaced color monitor; and more available expansion slots than you find in most small-footprint PCs. The combination of these features makes a cool Windows machine for an unbeatable price.



So You Wanta Fly? – by The Screamin' Vs

Power users, pick up the phone and order a Gateway 2000 VESA local bus 486 machine right now. You'll never regret it. With our 4DX2-50V or 4DX2-66V models, you get screaming PC performance. We put ATI's Graphics Ultra Pro video card with 1MB VRAM on our VESA local bus for results that are simply awesome! Plus these systems have a hefty 8MB RAM with cache, and hard-rockin' hard drives running on the local bus. Extra VESA local bus expansion slots, too. You get a 15-inch flat, square CrystalScan color monitor – our top-of-the-line – and more choices of cool application software than you'll find anywhere else.

*We custom-build
each Gateway 2000
computer to your order.
We'll gladly provide
you with a quote on a
special configuration.
Call our sales
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Big Bandwidth Boogie – by The Gates

If you're looking for the 32-bit power of an EISA system, we offer three models – 4DX-33E, 4DX2-50E and 4DX2-66E. All models include: 8MB RAM with 256K cache; a very large, very fast SCSI hard drive; 32-bit EISA SCSI controller; and a standard tower case. Please call for details and prices on models not listed on our price page.

Workin' Up Some New Riffs – by The Harmonics

This one's our theme song. At Gateway, we're always looking for ways to make your PC easier and more fun to use. For example, we now install a Mach 32 video driver icon in your Windows control panel so you can change your video resolution quickly and easily.

*All Gateway systems
go through extensive
compatibility testing
to ensure flawless
performance with all
products from major
software developers
and peripherals
manufacturers.*



8 0 0 - 8 4 6 - 2 0 6 3

◀ According to PC World, "(Gateway 2000's 4DX2-66V is)
by far the fastest machine we've ever tested!"



THAT

WORD

WORD

WINDOWS
FOR WORKGROUPS

EXCEL

WORD
MYSELF

WORD





Windows to the Other Side – by Tommy Gee

Gateway's album would also include jazz favorites because we offer a complete line of software and peripherals to make your system extra cool.



Software Improv – by Good Vibes

All Gateway systems come with some very hip software, all pre-installed and ready to run the moment your PC arrives. With mini desktop, desktop and tower systems that include "choice of application software," you get to pick one of the following applications, all latest versions:

- Microsoft® Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf 92® CD
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack (Works,™ Publisher,™ Money,™ and games)
- Borland Paradox® for Windows™
- The Windows Programmer Pack (MS Quick C,™ Visual Basic and more)
- Upgrade to Microsoft Office™ for \$175

All Gateway desktop systems also come with Cool Tools for DOS, a diagnostic and utilities package including QA Plus™ from Diagsoft, Central Point® Anti-Virus and more.

Connectivity – by The Local Area Group

TelePath™ Fax/Modem. A 14,400bps modem, V.32bis, with 9,600bps fax capability. Includes WinFax Pro, Crosstalk for Windows, Qmodem. \$195

Network Cards. Call for a selection of Ethernet cards and Token Ring adapters, installed and configured.

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WOW – by Talking Pictures in Motion

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Microsoft Windows Sound System.™ Package includes sound board, microphone, headset and software. \$149

Multimedia Accessories. Call for details on other multimedia hardware and software.

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◀ Gateway's 4DX-33V is shown here with Windows Sound System components, the CD-ROM kit and optional speakers. Call for details on this system.



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■ Notebook PCs

Floppy Drive or Extra Battery: Panasonic Lets You Choose

BY MATTHEW J. ROSS

Since NEC introduced its original UltraLite notebook computer back in 1988, a debate has raged over whether notebook PCs need a floppy disk drive or not. The \$1,899 Panasonic CF-1000 has rendered the point moot, while providing seven and a half hours of battery life.

The CF-1000 features a removable floppy disk drive, similar to the removable hard disk design in Epson notebooks, but Panasonic goes one step better. The vacant drive bay accepts a second nickel hydride battery, so you can have both long battery life and a built-in floppy drive without sacrificing portability.

TRAVELER

Portability is one of the CF-1000's strengths. With two batteries installed, the unit weighs 5 pounds, and you can shave another ounce or so off the CF-1000's total weight by switching one battery in favor of the half-pound floppy disk drive. And unlike some of the other lightweighters, there is nothing flimsy about this notebook. The rugged sleekness of the 1.25- by 11.7- by 9.25-inch (HWD) notebook is rivaled by its equally compact AC adapter, which looks like one of Toshiba's pocket-size transformers. The adapter adds just one pound to the unit (for a 6.6-pound total travel weight, including all cables) and takes up just a little more room in your briefcase.

Powering the CF-1000 is Advanced Micro Devices' 25-MHz Am386 SXLV, a low-power,

3.3-volt CPU. Also operating at 3.3 volts are the VLSI logic chip, the Cirrus video chip set, and the system RAM, which is expandable to 12MB. For now, the mechanical components (the 60MB hard disk and removable 1.44-inch floppy disk drive) operate at a standard 5 volts. The notebook's lower voltage components, combined with its APM (advanced power man-

agement) BIOS, the CF-1000 was able to successfully resume a Windows session after a shutdown.

LEGIBLE DISPLAY

Panasonic has done an excellent job of bringing together the best features currently available in notebook technology. A large 9.5-inch diagonal display performs well, and the sidelit LCD has three brightness settings: legible, long battery life, and one that's a happy medium. You can also set the 64 grayscale display to either 16 levels or simple black-and-white output for crisper text with character-based apps.

Also notable is Panasonic's enhanced screen support utility for text-based applications. Similar to Laptop UltraVision, it expands the usable area of the LCD from top to bottom, solving the laptop display crush. These tools and

the power-management settings are easily accessed from the CF-1000's setup utility; they can also be set individually from the DOS prompt.

OPTIONAL COMPRESSION

One other nice touch, showing Panasonic's appreciation of the notebook user's concerns, is providing SuperStor PRO compression software with the system. While the CF-1000 we tested had only a 60MB drive, SuperStor nearly doubled that to roughly 110MB of disk space. Best of all, the whole compression and decompression process is invisible (you can easily disable compression if you don't want it).

Panasonic said that the com-

pany will soon provide Softac's SoftMouse utility, in addition to the Windows 3.1 and SuperStor, which both come preinstalled with the CF-1000. SoftMouse allows users to move the Windows cursor from the keyboard. Panasonic doesn't include a mouse or other hardware pointing device with the CF-1000 notebook, but the keyboard is a full-size unit featuring full-travel keys, an inverted-T cursor arrangement, separate Home, End, PgUp, and PgDn keys, and twelve function keys.

THREE MODEMS

Available options for the system include a choice of three internal modems (two with fax support) and a docking station that accepts one full- and one half-length AT-bus expansion card. Panasonic is also considering adding a 120MB hard disk option to the line.

Panasonic is using targeted distribution to push the CF-1000 into Fortune 1000 accounts, a strategy similar to GRiD's. So if you aren't among the corporate elite, you may have some trouble finding the CF-1000, but look hard. This is a notebook that is long on flexibility, performance, and battery life that does not come up short at all. □



CF-1000: Configure it to your needs.

agement) BIOS, a host of user-selectable power-conservation features, and the second battery provide tremendous battery performance.

With the optional \$220 second battery included, the CF-1000 lasted 3 hours 54 minutes on PC Magazine Labs' worst case Battery Rundown test. When we implemented the notebook's super-long-life settings (with the COM port enabled so we could use a mouse under Microsoft Windows), the notebook ran for seven and a half hours. The system features both a standby and a resume mode; resume turns the system off entirely while preserving your last work environment in memory. Thanks to its APM

FACT FILE

CF-1000

Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000

List price: with 4MB RAM, 60MB hard disk \$1,899, docking station, \$600, 2400-bps modem, \$160, 2400-/9600-bps MNP 5 data/fax modem, \$280, 9,600-/14,400-bps V.32bis data/fax modem, \$500, extra battery, \$220

In short: Panasonic's CF-1000 has all the features a serious traveler needs in a lightweight notebook. Its removable floppy drive and support for a second battery are design innovations that all notebook users will appreciate.

ON READER SERVICE CARD

Windows Utilities

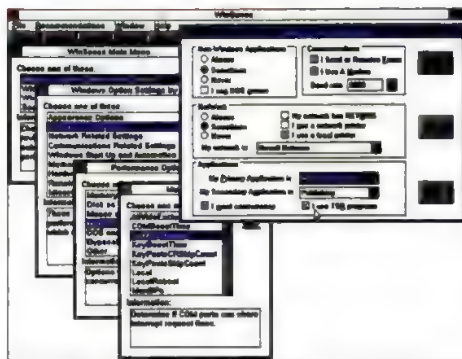
WinSense: The Automatic Way to Optimize Windows

BY EDWARD MENDELSON

WinSense, Version 1.1, asks how you work in Microsoft Windows, and then it optimizes the environment so that all your graphical applications work as well as they can. SoftLogic Solutions' \$49.95 utility does this job automatically, but it also gives you menus with which you can tweak hundreds of Windows settings by hand.

At the heart of WinSense is a

user profile menu where you report which network you use, the kinds of applications you use most, whether you use DOS applications, the speed of your modem, and other details. Then the program recommends changes in WIN.INI and SYSTEM.INI files to squeeze the last byte of RAM out of your system and to increase the speed and efficiency of Windows.



SELF-ANALYSIS: WinSense optimizes on the basis of your preferences.

Some of these recommendations modify existing lines in your system files. Others add lines that subtly alter Windows' default settings. If you don't

like the results, you can restore up to nine earlier states of your system files.

Like all powerful tools, WinSense works best when you use it cautiously. Its menus will let you make dangerous changes such as replacing your video driver, and the program won't advise you not to. It doesn't give adequate warning against changing settings

like VirtualHDIRQ=False that your hardware may need.

Other problems are harmless but confusing. On most systems, WinSense's optimization menu offers to "change" some settings to the same ones you already use, and offers to delete entries that aren't in your system files to begin with.

If you use WinSense to manipulate your Program Manager layout, you'll get an error message if you use more than 25 program groups, and the system information screen displays no more than four hard disk partitions. WinSense recognized that our system was using Norton's cache instead of SmartDrive, but mistakenly thought we had a 15MB cache and recommended that we lower that number.

WinSense won't help you with the more obscure entries in SYSTEM.INI that you probably shouldn't touch anyway, but if you use it with care, WinSense can do more to optimize Windows performance than any other utility on the market, and buyers of the first release can expect a free upgrade to an improved version already in the works.

• List price: WinSense, Version 1.1, \$89.95 (\$49.95 until April 15, 1993). Requires: 2MB RAM, 1.5MB hard disk space, Microsoft Windows 3.0 or later. SoftLogic Solutions, 1 Perimeter Rd., Manchester, NH 03103; 800-272-9900, 603-627-9900; fax, 603-627-9610.

rent year actuals or budget. Departmentalized financial statements can be printed, but you must build your report format into the chart of accounts.

BusinessWorks provides numerous reports in both AR and AP; AR has more than 20 standard reports. An especially useful report in both modules is the Detail Report which lists all transactions for a customer or vendor. It's an excellent tool for an audit of an account.

Missing from Manzanita's first Windows release is DDE or OLE support, and there's only limited font support for screen and report printing.

If your current low-end accounting system doesn't seem to be keeping up with your business, but you're worried about the learning curve associated with more powerful accounting packages, BusinessWorks Accounting for Windows is a happy medium.

• List price: BusinessWorks Accounting for Windows, Version 7.2: System Manager, \$95; modules, \$295 each; Standard System Bundle, \$795. Requires: 2MB RAM, 4MB hard disk space, Microsoft Windows 3.1. Manzanita Software Systems, 2130 Professional Dr., #150, Roseville, CA 95661; 800-447-5700, 916-781-3880.

Circle 420 on reader service card

Accounting Software

BusinessWorks: Midrange Accounting with Ease

BY TOM WHITE

Microsoft Windows-based accounting software has been rapidly gaining acceptance at the low end of the accounting market. However, Windows versions of more powerful DOS-based accounting products have been slow to arrive.

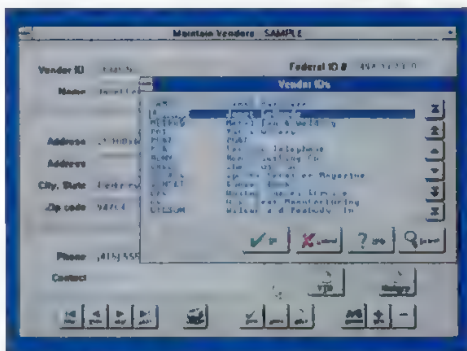
Manzanita Software Systems' new Windows offering, BusinessWorks Accounting for Windows, proves that a graphical interface can enhance midrange accounting by simplifying the learning curve.

BusinessWorks for DOS is known for its mix of powerful features and ease of use. The new BusinessWorks Accounting for Windows (\$295 per module, \$95 for the System Manager) includes virtually the same functionality of the DOS product, but with standard Windows functions such as com-

mand buttons and pull-down list boxes, along with well-designed search and lookup functions, everything is just a mouse click away.

Manzanita is releasing its product in phases. General Ledger, Accounts Payable, Accounts Receivable, and the System Manager are available now. Payroll, Inventory, and Job Cost should be out by the year's end.

The General Ledger lets you



WINDOWS ACCOUNTING: You can search for a vendor in a number of ways.

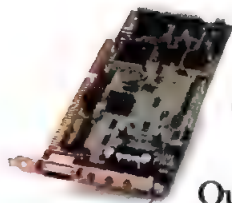
create three budgets (prior, current and next year) and have the system automatically calculate your budget based on a percentage increase or decrease of cur-

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"This is the best PC sound board..."
T. Yager, *Byte*, Dec. '92

"...one of the best all-around, affordable multimedia sound boards."

T. Carlton, *PC Games*, Mar. '93

"For my money, the PAS16 is the best deal going."

R. Lauriston,
PC World, Nov. '92



"The PAS 16 is currently the best deal available in a 16-bit card."

D. English, *Compute*, Jan. '93

"...Media Vision has done well with its Pro AudioSpectrum line, which is compatible with Sound Blaster, but I think is even better."

W. S. Mossberg,
Wall Street Journal, Oct. '92



"Those looking to add high-fidelity sound to their multimedia presentations should be pleased with this board's capabilities."

J. Quain, *PC Magazine*,
Sept. '92



Best Peripheral 1992
Pro AudioSpectrum 16



MEDIA VISION

■ LAN Monitoring Software

Intel Takes Colorful Approach To LAN Management

BY M. KEITH THOMPSON

LANDesk Manager, Version 1.0, the foundation for Intel Corp.'s Microsoft Windows-based LAN-management strategy, brings comprehensive monitoring and control to Windows users for \$995 per server, a price that is competitive with its peers. LANDesk's utilities colorfully automate the labor-intensive and frustrating aspects of the network administrator's job. The package's easy-to-use tools manage configurations and optimize performance, troubleshooting, accounting, and inventory tracking.

APPLICATION MONITOR

LANDesk's Application Monitor has a feature not found in any other low-cost LAN-management program: a utility that identifies which applications run on which servers, how often they are run, and which users access them. Armed with this valuable information, network administrators can better service their users.

With the Application Monitor, LAN administrators can proactively allocate programs to various servers on the network. This allocation lets the network manager load-balance the network, eliminating potential bottlenecks. The Application Monitor also serves as a software-validating tool for network licensing.

Three easy-to-read reports provide detailed information about network activity. The *server load* report shows the servers used most often, while the *application distribution* report shows the response times

for each application and which server is doing the work. There's also a *user accounting* report. The report data can be viewed on-screen or exported as text.

TRAFFIC MONITOR

LANDesk's Traffic Monitor has three different displays showing the level of packets traveling across the network, all in real time. Thermometers display the packets-per-second, utilization, and error rates; a histogram shows the level of traffic over a scalable time period; and the screen keeps a running total of packets.

LANDesk knows about AppleTalk, NetWare, TCP/IP, and VINES packets, but lacks support for NetBEUI or SMB packets used in LAN Manager/Server (these can be added later). The Traffic Monitor is not a protocol analyzer and will not examine the contents of packets.

An Alert Log recognizes predetermined events in the

these alerts in the style of Frye Computer Systems' NetWare Early Warning System.

INVENTORY MANAGER

LANDesk's Inventory Manager is as comprehensive and flexible as any on the market, storing the



APP MONITOR: The bar graph shows how much traffic is related to each application.

hardware and software configuration for each computer on the network. Items detected include system type, BIOS version, system bus type, amount of RAM, video card type, drive types and capacities, I/O port types, DOS version and network card types.

Virus protection adds to the security of any network, and LANDesk's virus-scanning tool detects and removes over 1,900 strains of viruses.

A Server Monitor queries file servers, print servers, and gateways, and a Queue Monitor displays summary information for all print queues. Both display their findings graphically.

To let LAN administrators handle potential problems while they're on the road, LANDesk includes a remote-access program so an administrator can dial in to an administrative PC

and conduct work remotely.

There's also a File Transfer utility to send files to and from users' computers, and a chat facility that lets the administrator communicate with users by typing in a small window on the screen.

LANDesk's first-rate documentation includes insights into LAN management and detailed explanations of how to incorporate third-party programs into the management picture.

Intel knows that standards in the PC world evolve rapidly, so the company has designed

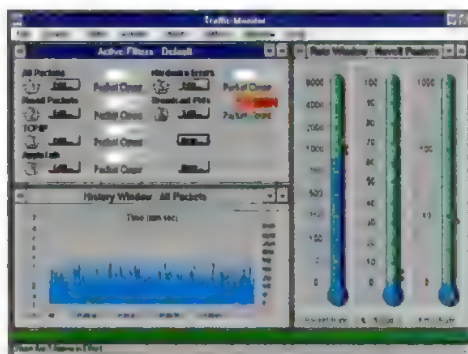
LANDesk to be expandable. Additionally, Intel plans to include a protocol decoding facility for the Traffic Monitor in a future release. Intel sees LANDesk as the ground floor of an architectural strategy designed to provide future solutions for desktop and LAN

management. Future versions of LANDesk will include support for Desktop Management Task Force DMI (Desktop Management Interface) when reference tools become available.

LANDesk lets network administrators running Windows make LAN administration consistent and simple. With improvements to the Traffic Monitor and the Alert module, LANDesk is expected to be a leading contender in the LAN utilities market.

• **List price:** LANDesk Manager, Version 1.0: \$995 per server. Requires: server, 25-MHz 486-based processor or better, 12.3MB hard disk space, NetWare 3.11; administrative PC, 33-MHz 386 processor or better, 8MB RAM, DOS 5.0, Microsoft Windows 3.1. Intel Corp., 5200 N.E. Elam Young Pkwy., Hillsboro, OR 97124; 800-538-3373, 503-629-7354; fax, 800-525-3019, 503-629-7576.

Circle 423 on reader service card



TRAFFIC MONITOR: The thermometer shows NetWare packet volume.

other modules. When an alert condition occurs, a message pops up on the LAN administrator's screen or on any other designated computer. This feature would be better if Intel included a mechanism to act on

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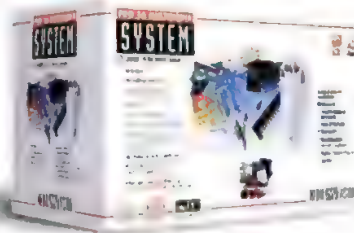
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And, the double speed SCSI NEC CD-ROM drive delivers twice the throughput (300kB/sec) and has three times faster access (280ms) than other CD-ROM drives—greatly exceeding MPC specifications.

Here's what **PC Magazine** says, "Those who want the best sound possible out of their multimedia PC upgrade kits should remember this name: Media Vision."

So see your dealer now and get the new Pro 16 Multimedia System from Media Vision.



CIRCLE 093 ON READER SERVICE CARD

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■ Multimedia

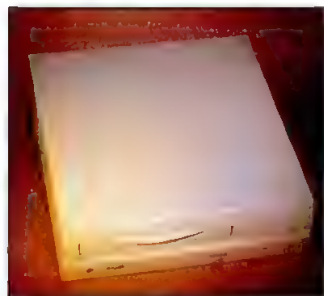
New \$895 Toshiba CD-ROM Drive Doubles Performance

BY JOHN R. QUAIN

Offering twice the throughput of conventional CD-ROM drives, double-speed CD-ROM drives continue to gain in popularity. The newest competitor is Toshiba's \$895 TXM-3401E.

Toshiba's double-speed external drive includes a 256KB data buffer, a built-in SCSI-2 terminator, an automatic lens cleaner, and a one-disk caddy. (An optional \$150 adapter kit includes the MSCDEX driver and connecting cables.)

Like other double-speed players, the TXM-3401E delivers higher data throughput by spinning and decoding disks containing text, graphics, and video at twice the standard rate.



SPINNER: The TXM-3401E

Consequently, it improves the look of full-motion video and the speed of searches with a rated average access time of 200 ms—compared to the 380-ms rating of conventional drives.

In PC Magazine Labs' performance tests, sequential accesses of 65K files yielded an average data transfer rate of 332KBps. This easily outdistances the throughput of standard 150KBps CD-ROM players and offers enough speed to visibly improve the performance of MPC-compliant multimedia CD-ROM applications.

Installing Toshiba's SCSI-2 player poses little difficulty. An automated utility puts the ap-

propriate driver statements into the AUTOEXEC.BAT and CONFIG.SYS files.

The external player uses a caddy design with a flip-down front door. On the front-panel

■ PCs

Digital Mini-Tower Holds More in Less Space

BY BRUCE BROWN

Digital Equipment Corp. has introduced the DECpc MT series, three space-saving mini-tower PCs that offer more drive expansion than the company's low-profile LP series.

Unlike large towers, the 17-inch-high mini-tower is designed to be placed on the desktop, taking a space only 7 inches wide and 17 inches deep. Despite this size, the case holds one internal 3.5-inch drive, one externally accessible 3.5-inch drive and three 5.25-inch drives.

The 66-MHz 486DX2-based DECpc 466d2 MT lists for \$2,799 with 4MB RAM and a 122MB hard disk. Digital also sells a 486DX/33 for \$2,349 and a 486DX2/50 for \$2,499 in the same configuration. Our \$3,364 test unit had 8MB RAM and

there's a headphone jack with volume control, an eject button, and power and busy light indicators. On the backside are stereo RCA jacks, a SCSI address selector, and two SCSI connectors for daisy-chaining up to seven SCSI devices.

In addition to being compatible with standard ISO 9660 CD-ROM disks, the TXM-3401E can read disks conforming to Kodak's multisession

Photo CD specification. Audio CDs are handled via digital-to-analog converters.

• List price: Toshiba TXM-3401E, \$895 with one CD caddy. Requires: 8-bit ISA slot, DOS 3.0 or later. Toshiba America Information Systems Inc., Disk Products Division, 9740 Irvine Blvd., Irvine, CA 92713; 714-583-3111; fax, 714-583-3133.

Circle 433 on reader service card



SPACE SAVER: DECpc MT mini-towers sit on the desk.

a 245MB Quantum hard disk.

Manufactured by Digital, the 466d2 MT motherboard's processor module holds the CPU, external cache controller, and cache memory. Four SIMM sockets can hold up to 64MB of system RAM. Systems in this series feature Intel OverDrive sockets for board upgrades.

Because video, drive, and I/O circuitry are integrated on the motherboard, six full-length 16-bit ISA slots are empty.

The 466d2 MT's integrated video circuitry is first rate, thanks to its S3 924 Windows accelerator video controller and a 24-bit Sierra RAMDAC. With 1MB VRAM, these components support up to 256 colors from a palette of 16.7 million colors in 1,280-by-1,024 resolu-

tion. Our test unit maxed out at 1,024-by-768 noninterlaced.

DEC offers a one-year warranty on parts and labor, free on-site service, a 30-day money back guarantee, and toll-free support.

• List Price: DECpc 466d2 MT, with 8MB RAM, 256K RAM cache, 245MB hard disk, 14-inch SVGA monitor, DOS 5.0, Windows 3.1, \$3,364. Digital Equipment Corp., 50 Nagog Park, Acton, MA 01720; 800-722-9332; 508-493-5111; fax 800-524-5694.

Circle 425 on reader service card

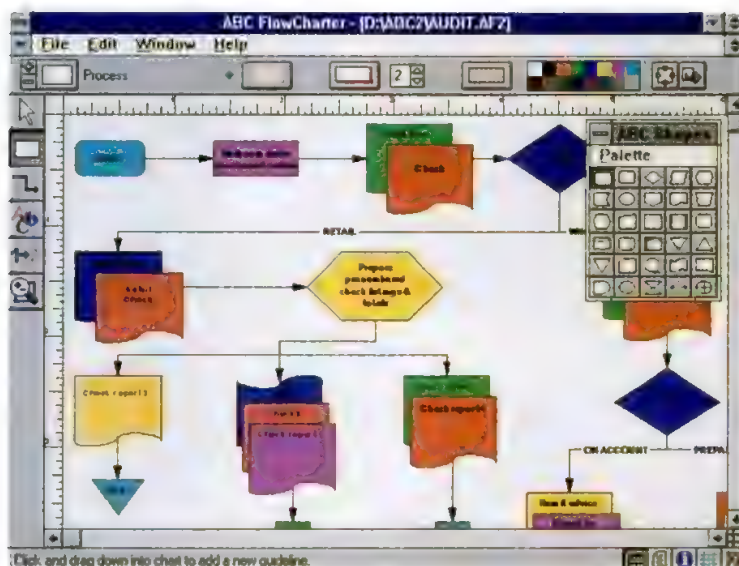
Benchmark Tests: DECpc 466d2 MT

We compared the test results of the DECpc 466d2 MT with the average of 74 486DX2/66s tested in the January 26, 1993, issue of PC Magazine. The 466d2 MT performed about as well as other machines in its category, falling somewhat below average on memory, DOS video, and disk scores.

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.0, to measure each PC's processor, memory, video, and disk subsystem performance. The DOSmark is a composite rating derived from these four tests, and indicates a PC's ability to run DOS applications. The Graphics Winmark is based on 12 Microsoft Windows graphics and text functions, weighted to reflect how frequently the various functions are used.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Video (millions of operations per second)	Disk (kilobytes per second)	DOSmark	Graphics Winmark (megapixels per second)
DECpc 466d2 MT (486DX2/66)	16,388	4,719	2.09	40.06	38.13	9.96
486DX2/66 average	15,355	6,305	3.78	47.66	39.74	8.09

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InfoWorld
April 20, 1990

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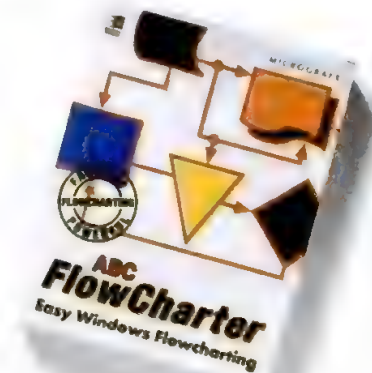
DBMS Magazine
August 1991

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CIRCLE 361 ON READER SERVICE CARD

Printers

Avery's Label Printer Goes Windows

BY STAN MIASTKOWSKI

Avery Dennison has finally shipped a Microsoft Windows interface for its popular Personal Label Printer. If you're buying the whole setup, the new software doesn't increase the printer's \$249.95 price, but if you already have the printer, you'll pay an additional \$29.95.

The Personal Label Printer (PLP), which has been available for a couple of years, isn't fancy. It does exactly what it's supposed to do—print labels—and

it performs well. The PLP plugs into a serial port, grabs an address from the screen, and thermal prints it onto a roll of labels.

DOS software, which is still shipped with the printer, is simple, albeit limited. A pop-up program recognizes an address on the screen and prints it. It can even add a Postal Service-approved bar code to the label.



MULTIPLE MARKS: The PLP's new Windows interface has label-making flexibility.

The new features in the Windows version of the PLP are eminently useful. There are macros for Ami Pro, Microsoft Word for Windows, and WordPerfect for Windows that automatically grab an address and print a label

while your main printer simultaneously prints the document. If you use another Windows word processor, things get more complicated.

The PLP's new software includes an address book that imports dBASE files or ASCII text. There's also List Book, a utility that sets up categories for non-address labels such as videotape labels.

- **List price:** *Personal Label Printer*, \$249.95; upgrade from DOS version, \$29.95. Requires: 2MB RAM, Microsoft Windows 3.0 or later, serial port. Avery Dennison, Avery Division, 20955 Pathfinder Rd., Diamond Bar, CA 91765; 800-252-8379, 909-869-8755; fax, 909-598-2905.

Circle 429 on reader service card.

PCs

CompuAdd's 450SLC2: IBM Brain by Mail

BY BRUCE BROWN

Now you can get an IBM motherboard and CPU in the form of a low-profile CompuAdd desktop system.

The CompuAdd 450SLC2 is based on an IBM-manufactured motherboard and uses IBM's own Intel-compatible, 25-MHz 486SLC2 processor. With its 32-bit internal and 16-bit external data path, IBM's CPU differs from Intel's 80486, but the instruction set is 486-compatible and the CPU has a 16K cache. The chip's clock doubler allows internal instructions to be processed at 50 MHz.

A CompuAdd 450SLC2 with 4MB RAM and a 170MB hard disk starts at \$1,695. Our \$2,103 test system came with 8MB of RAM and a 245MB Quantum hard disk.



HYBRID: The CompuAdd 450SLC2 performs like a 486/33.

This unit performed comparably with 486/33s systems. Compared with a Compaq Deskpro M 486/33, the 450SLC2 was a bit slower on DOSmark, processor, memory, and disk tests. The sys-

tem had a somewhat better DOS video score, but the Graphics Winmark was low.

The 450SLC2's 16-by 15.5-inch case stands 4 inches high. Horizontally configured expansion slots can hold three 16-bit ISA cards and one 8-bit full-length ISA card, as well as a half-length 8-bit card.

The motherboard also contains two serial ports, one parallel port, one VGA port and a standard keyboard port.

There are only three drive bays in the 450SLC2 case: two 5.25-inch and one internal 3.5-

inch bay. CompuAdd saves space by installing a combination 1.2MB/1.44MB Teac floppy disk drive.

The motherboard's video circuitry has a Western Digital Paradise video accelerator and a Brooktree RAMDAC controller. The 60-Hz, 14-inch monitor supports 1,024-by-768 noninterlaced video.

- **List price:** *CompuAdd 450SLC2 with 8MB RAM, 245MB hard disk, 1,024-by-768 display, Cyrix math coprocessor, DOS 5.0, Windows 3.1*, \$2,103. CompuAdd Computer Corp. 12303 Technology Blvd., Austin, TX 78727; 800-456-3116; 512-250-1489.

Circle 424 on reader service card

Benchmark Tests: CompuAdd 450SLC2

The CompuAdd 450SLC2, with its IBM 486SLC2 chip, yields results comparable with those of a 486DX/33, though there are several differences between the Intel 486DX and IBM 486SLC2 architectures. The IBM CPU features a 32-bit internal data path and a 16-bit external path, a 16K internal cache, and no internal coprocessor. Like the Intel 486DX2, the IBM 486SLC2 runs at 50 MHz internally and 25 MHz externally.

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.0, to measure each PC's processor, memory, video, and disk subsystem performance. The DOSmark is a composite rating derived from these four tests, and indicates a PC's ability to run DOS applications. The Graphics Winmark is based on 12 Microsoft Windows graphics and text functions, weighted to reflect how frequently the various functions are used.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Video (millions of operations per second)	Disk (kilobytes per second)	DOSmark	Graphics Winmark (megapixels per second)
Compaq Deskpro M (Intel 486DX/33)	7,910	5,690	3.39	42.21	34.68	8.09
CompuAdd 450SLC2 (IBM 486SLC2 25/50)	7,424	4,812	4.17	37.89	31.27	4.23

TRACKBALL. 486 POWER. COLOR. WHEN CLINTON SAYS SACRIFICE, HE MUST MEAN THE OTHER NOTEBOOKS.



January 1993

\$2699

Hyundai 486SLC Spectra Color Notebook

- ★ 25 MHz 486SLC
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- ★ Built-in trackball
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- ★ Built-in FAX and Data Modem
- ★ Made in the U.S.A.
- 9" color LCD
- DOS 5.0, Windows 3.1, WinFax preloaded
- 12-month on-site service
- 18-months parts & labor warranty



NEW BREED

Compare the Hyundai 486SLC Spectra to other notebooks, and you'll be shocked by how much they've sacrificed performance and value. On the other hand, our powerful notebook is so rich in features that *Home Office Computing* selected it as the best notebook in its class. The trackball, 486 power and color display make it ideal for running Microsoft Windows. And the price makes it one of the best values on the market.

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CIRCLE 275 ON READER SERVICE CARD

PCM 123

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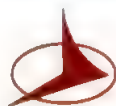
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CIRCLE 148 ON READER SERVICE CARD

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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

NEW

ALR Ships High-Performance, Local-Bus PCs

Advanced Logic Research is taking on Compaq with its ALR Evolution IV line of high-performance VESA local-bus desktop PCs. Evolution IV systems come in ISA and EISA flavors with 170MB or 240MB hard disks, 14- or 17-inch monitors, and Intel processors ranging from a 25-MHz 486SX to a 66-MHz 486DX2. For your local-bus video, you have the choice of Western Digital's Local Bus Graphics Accelerator, ATI's Ultra Graphics Pro adapter, or ALR's new proprietary Tri-Combo I/O adapter, a local-bus card carrying the ATI 68800 graphics accelerator, a 256K RAM cache, and AMD's PCnet-ISA Ethernet chip.

• List price: *ALR Evolution IV; ISA-based systems*, \$1,929 to \$2,979; *EISA-based systems*, \$2,129 to \$3,229. *Advanced Logic Research Inc.*, 9401 Jeronimo, Irvine, CA 92718; 800-444-4257, 714-581-6770; fax, 714-581-9240. Circle 401 on reader service card

NEW

Mitsubishi Introduces 300-dpi Color Dye Sublimation Printer

Since dye sublimation printers capable of delivering near-photographic quality first arrived in PC Magazine Labs last year, Mitsubishi and Tektronix have been the dominant players in the market. Now **Mitsubishi Electronics America** is calling the next shot with its 300-dot-per-inch S3600-30U color dye sublimation printer. It comes with a four-color, 32MB full-frame buffer for printing multiple copies, and a front panel where you can make color corrections, calibration adjustments, and contrast and sharpness adjustments. The Mitsubishi S3600-30U has both parallel and SCSI-2 interfaces, and supports monochrome, three-color, and four-color ink sheets while printing on letter- and legal-size paper.

• List price: *Mitsubishi S3600-30U*, \$8,995. *Mitsubishi Electronics America Inc.*, Professional Electronics Division, 800 Cottontail Ln., Somerset, NJ 08873-6759; 908-302-2855; fax, 908-563-0713.

Circle 402 on reader service card

Photography by Thom O'Connor

HOT PROSPECT



Adobe Photoshop Enters Windows Market with Flying Colors

Adobe Systems is bringing Adobe Photoshop to the Microsoft Windows arena, and it promises to be the hottest new kid on a block crowded by such veterans as Aldus PhotoStyler, Micrografix's Picture Publisher, and ZSoft's Publisher's Paintbrush. Photoshop 2.5 for Windows flexes such muscular new features as Dodge & Burn, a tool that selectively lightens or darkens certain parts of an image while leaving the rest of the image intact.

Equally impressive are Photoshop's various filters which apply special effects such as blurring and embossing to your images. You can even create your own special effects and save them as custom filters. Photoshop's Variations feature lets you work interactively to correct an image's color by adjusting brightness, contrast, hue, and saturation. You can preview a range of options and then click on your choices to apply them to the image.

Among the over 400 functions and tools included in Photoshop are the ability to perform color separations and to create, view, and edit transparent masks. The program offers support for MDI (Multiple Document Interface), and support for TrueType and Type 1 fonts.

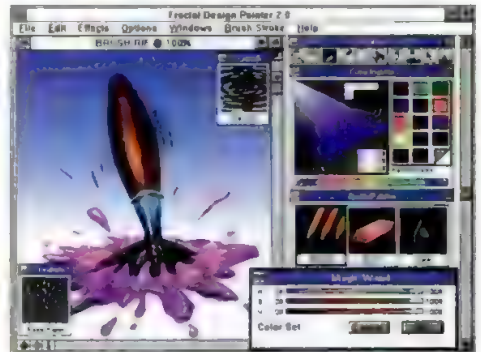
• List price: *Adobe Photoshop Version 2.5 for Windows*, \$895. *Adobe Systems Inc.*, 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; 800-833-6687, 415-961-4400; fax, 415-961-3769

Circle 417 on reader service card

IMPROVED

Picasso Would Love Fractal Design's Painter Upgrade

Not one to rest on its laurels, **Fractal Design Corp.** is shipping a major upgrade to Fractal Design Painter for Windows, a PC Magazine Technical Excellence award winner. Version 2.0 has features you've been expecting, such as four-color separations, image-editing tools, and snap-to grid paper, and features you've never seen at this level, such as the ability to create glass and marbling effects and to apply theatrical lighting to images. And nothing is more compelling than the "Liquid Media" tools that let you distort an image with a brush or stylus as if it were liquid.



Fractal Design Painter's "Liquid Media" will dazzle.

• List price: *Fractal Design Painter for Windows, Version 2.0*, \$399. *Fractal Design Corp.*, 335 Spreckels Dr., Suite F, Aptos, CA 95003; 408-688-5300; fax, 408-688-8836.

Circle 403 on reader service card

NEW

Link Multiple Peripherals Through Your COM Port

Gigatec has introduced the LiSBUS Async I/O System Development Pack, a method for connecting more than 100 peripherals at distances of up to 4,500 feet to a single controlling computer through the RS-232 COM port. Three modules make up the basic LiSBUS system: a Bus Interface Processor (BIP) for the controlling computer, an Input/Output Module (IOM) for each peripheral, and a Bus Terminator Module (BTM) which serves as an IOM and

New & Improved

also terminates the bus. LiSBUS Link Control Software manages the system by linking the peripherals and setting parameters, and LiSBUS Software Development Tools allow you to create custom applications for managing linked peripherals. If you need higher performance than RS-232, Gigatec offers converter modules and plug adapters for RS-423 and RS-422A.

● List price: *LiSBUS Async I/O System Development Pack* (connects up to four peripherals), \$1,275. Gigatec Inc., 871 Islington St., P.O. Box 4705, Portsmouth, NH 03802-4705; 800-945-3002, 603-433-2227; fax, 603-433-5552. Circle 404 on reader service card

NEW

CompuAdd Express 425ColorPlus: Active-Matrix Color and More

Active-matrix color has found its way to **CompuAdd Express** in the form of the new 425ColorPlus notebook, based on a 25-MHz Cyrix CX486SLC processor. In addition to the dazzling 8.5-inch display, the ColorPlus comes with all the little extras that characterize

CompuAdd Express notebooks, including a built-in trackball, a 9,600-bps fax modem, a SCSI-2 interface, and built-in virus protection. The standard model also ships with 8MB of RAM, a 200MB hard disk, and a slew of software including BitFax and LotusWorks.



The CompuAdd Express 425ColorPlus beams active-matrix color on its 8.5-inch display.

● List price: *CompuAdd Express 425ColorPlus*, \$3,995. CompuAdd Express, 12306 Technology Blvd., Austin, TX 78727; 800-925-3000, 512-219-1800; fax, 512-219-2890.

Circle 405 on reader service card

IMPROVED

Freedom of Press Now Supports More HP and Canon Printers

If you don't own a PostScript printer but want to take advantage of the PostScript language, try a compatible interpreter. Version 3.02 of **ColorAge's** PostScript interpreter software, *Freedom of Press for Windows*, now supports the HP DeskJet 550C, DeskJet Portable, LaserJet 4,

BRIEFS

MULTIMEDIA

Sigma Designs is shipping the WinSound 16 CD-ROM Multimedia Upgrade Kit (\$799) which includes the new WinSound 16 multimedia adapter (with CD-ROM, joystick, and MIDI interfaces), a Sony CD-ROM drive, 3-inch speakers, and an IBM-compatible joystick. To get you up and running, Sigma throws in six CD-ROM applications including Asymetrix's Multimedia Make Your Point, Compton's Multimedia Encyclopedia, and Midisoft's Multimedia Music Library. 800-845-8086, 510-770-0100

Also from **Sigma Designs** is the WinStorm CD-ROM Kit (\$1,199) which includes the WinStorm adapter, a Windows accelerated 24-bit video adapter with 16-bit sound and SCSI interface. This kit gives up the speakers and joystick for true-color video, but it still includes a wealth of software including Kodak Photo CD Access software. Both kits are compatible with the Kodak Photo CD system. 800-845-8086, 510-770-0100.

Genoa Systems Corp. has added AudioBahn (\$399), an MPC-compatible audio card, to its product line. It is compatible with Sound Blaster and Ad Lib cards and features SCSI, MIDI, and joystick interfaces, plus a stereo line out/speaker connector. Speech recognition is possible through a digital signal processing chip. 800-934-3662, 408-432-9090.

PC Vendor **Micro Express** has introduced its Multimedia Upgrade Kit (\$399) that will work with any manufacturer's PC. It includes a Sony CD-ROM drive, a Creative Labs' Sound Blaster card, a pair of Labtech stereo speakers, and a microphone. 800-989-9900, 714-852-1400.

Advanced Digital Systems is shipping two video boards, Video Clipper (\$465) and PC PrimeTime (\$499), with multimedia capabilities. Video Clipper works with Microsoft Video for Windows and lets you capture and display real-time or step-frame video from a variety of sources including laserdisc players, VCRs, or TV tuners. Motion

and PaintJet XL300, plus the Canon BJ-200, BJ-10ex, BJ-10sx, BJC-800, and BJC-880. The new version allows you to convert PostScript files to .DCX and .PCX formats for higher-quality output from fax applications. It includes 35 scalable and rotatable outline fonts equivalent to Apple LaserWriter IINT fonts, and support for hinted Adobe Type 1 and ATM fonts.

● List price: *Freedom of Press for Windows, Version 3.02*, \$299. ColorAge Inc., 900 Technology Park Dr., Billerica, MA 01821; 508-667-8585; fax, 508-667-8821.

Circle 406 on reader service card

NEW

New Utilities Test High-Res Monitors and VESA Adapters

Sonera Technologies' new DisplayMate Professional represents a new generation of video utilities, picking up where DisplayMate left off in setting up, evaluating, testing, and adjusting monitors and video adapters. DisplayMate Professional measures frequencies and timings, interlacing, refresh rates, dot clock rates, and required bandwidths at all VESA-compliant Super VGA adapter modes, including 1,280-by-1,024 with 256 colors. Non-standard values are flagged and put in a set of reports that can be printed or saved to disk.

● List price: *DisplayMate Professional*, \$249. Sonera Technologies, P.O. Box 565, Rumson, NJ 07760; 800-932-6323, 908-747-6886; fax, 908-747-4523.

Circle 407 on reader service card

NEW

SmartScreen Message Manager Handles PROFS, OfficeVision

Capella Systems has introduced a solution for anyone who needs to send and receive e-mail across both host- and LAN-based systems. SmartScreen Message Manager supports both types of e-mail systems without needing a separate mail gateway, so now, if you need to, you can access e-mail across your LAN-based MAPI system and PROFS or OfficeVision/VM from the same interface. It's a client application that integrates and manages dissimilar e-mail systems, specifically supporting PROFS, OfficeVision/VM 1.1 and 1.2, and all MAPI-based LAN servers.

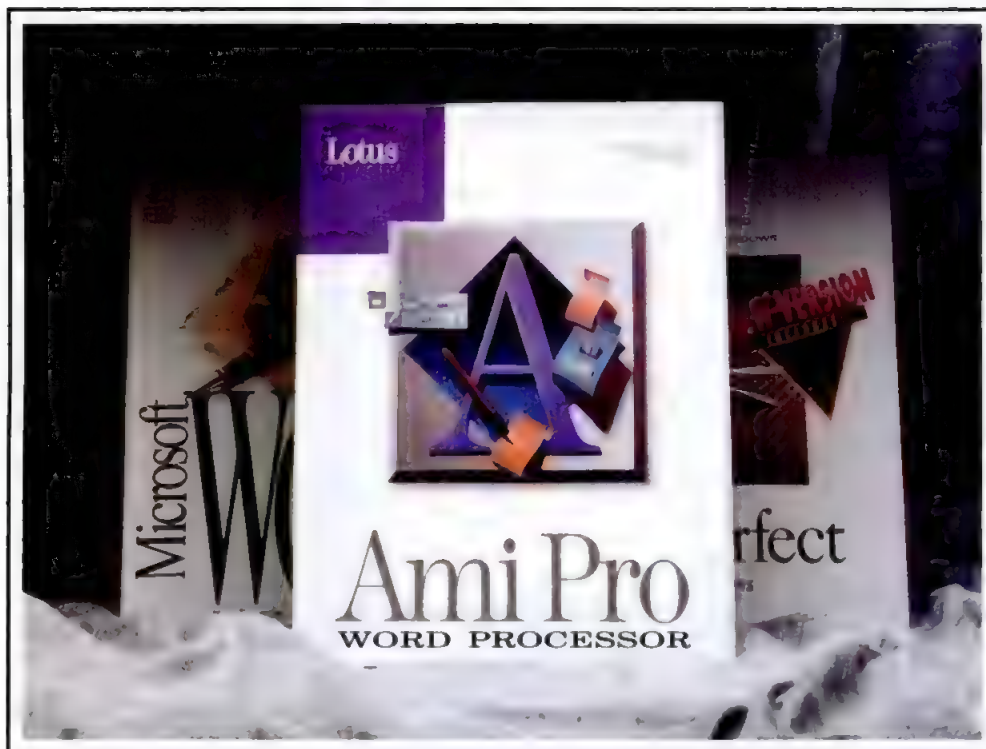
● List price: *SmartScreen Message Manager, Version 1.0*, \$495. Capella Systems Inc., 1303 Hightower Trail, #350, Atlanta, GA 30350; 404-552-9910; fax, 404-552-9912.

Circle 408 on reader service card

There's
quite a battle
raging between
Word and
WordPerfect.



For seco



Check the rankings.

Ami Pro 3.0 is ranked the #1 Advanced Word Processor for Windows™ by the National Software Testing Laboratories. (9/92)†

Recently, in an InfoWorld review, Ami Pro received the highest score ever given for a Windows word processor. (9/28/92)

Lotus Ami Pro captured the 1992 PC Computing MVP Award. (12/92) (Note: The MVP award also

appears in the new WordPerfect ad. That's last year's award.)

PC Magazine recently named Ami Pro one of the Best Products of 1992. They said, "No other product can match...the sheer pleasure of using it." Microsoft Word received an Honorable Mention, with the comment "...it's a step behind Ami Pro." (1/93)

Now, perhaps the battle royale between Word and WordPerfect has been put into perspective.

And you probably wonder what it is that makes Ami Pro clearly better?

In the War of the Words, there's one clear winner. Ami Pro.

Word vs. WordPerfect®. It's billed as the battle of the world's two greatest word processors. Hardly.

According to most independent judges, Lotus® Ami Pro® 3.0 is the clear and convincing leader of the word processing pack. Word and WordPerfect are following its lead, scrapping it out for second and third.



nd place.

The battle of the features.

Simply put, Ami Pro is a faster, easier, friendlier word processor to use. It does so many things with so little effort, most people never even bother to open the manual.

To name a few, there's real, honest, no ifs-and-or-buts WYSIWYG. There's Fast Format, for quick repetition of text formats. There are customizable, editable SmartIcons.[™] Not to mention SmartClick, where the right mouse button will automatically shift you to the appropriate dialogue box to change fonts, styles or frame formats, based on what you're doing.

There's automatic renumbering of lists. Preview of Style Sheets. QuickStart on-line tutorial. Free 24 hour a day technical support.* And to ease your mind, a 60-day money back guarantee of your complete satisfaction.

And, if you're switching from WordPerfect for DOS, relax. Ami Pro makes it easy with a number of special features. Like seamless conversion of WordPerfect files. And a SwitchKit so that when you type in WordPerfect commands,

Ami Pro shows you how to perform the same functions using pull-down menus or one-click SmartIcons.

You call the winner.

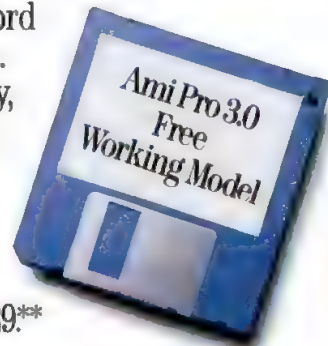
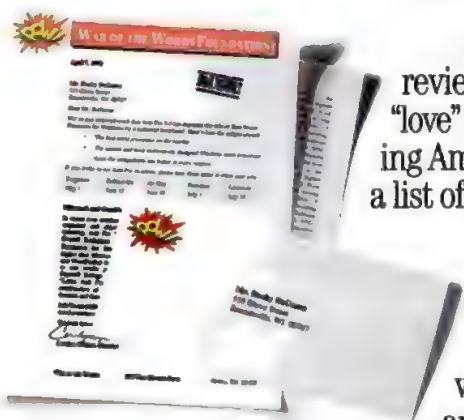
So what drives hardened reviewers to use words like "love" and "pleasure" when describing Ami Pro? You can't tell from a list of features.

You've got to experience it. In your office. On your PC.

Call us for a free working model of Ami Pro and you'll see for yourself.

If you're like most people, once you actually sit down with Ami Pro, you'll definitely choose it. Over Word. Over WordPerfect. Over every other word processor out there.

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Lotus **Ami Pro 3.0**
Word Processor for Windows

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CIRCLE 143 ON READER SERVICE CARD

NEW

Two New Video Accelerators from SixGraph Computing

SixGraph Computing Ltd. is shipping two new video accelerator cards for CAD and Windows applications. The Wizard 924 Graphics Accelerator uses an S3 chip and 1MB of VRAM, and can display 16.7 million colors at 640-by-480 resolution, 256 colors at 800-by-600 and 1,024-by-768 resolutions, and 16 colors at 1,280-by-1,024 resolution.

The Wizard 9000 VL Bus Graphics Accelerator is based on the Weitek Power 9000 chip set and comes standard with 2MB of VRAM. This unit displays 16.7 million colors at 800-by-600 resolution, and can deliver 65,536 colors at 1,024-by-768 and 256 colors at 1,280-by-1,024. The VESA-standard 72-Hz flicker-free refresh rate is supported at all of these resolutions.

• List price: *Wizard 924 Graphics Accelerator*, \$295; *Wizard 9000 VL Bus Graphics Accelerator*, \$675. *SixGraph Computing Ltd.*, 5 Harborview Dr., Hingham, MA 02043; 617-740-0032; fax, 617-740-4081.

Circle 409 on reader service card

NEW

Philips's New CD-ROM Products Include Portable Multimedia

Philips Consumer Electronics recently launched an assault on the CD-ROM market with a variety of new products. The Philips CDI 350 is a portable Compact Disc-Interactive (CD-I) multimedia delivery system with a 6-inch active-matrix screen, built-in pointing device, stereo speakers, and multiple audio/video connectors. The new RapidReader series of double-speed SCSI CD-ROM drives begins with internal (CM405ABK) and external (CM425ABK) models featuring multisession and photo CD capabilities, a 64K buffer, and a self-cleaning lens mechanism. And the new CDD521GN Desktop CD-Recorder System comes with CD-GEN Publishing Software, a DOS-based program for recording data, image, and application files to CD-Recordable (CD-R) discs, and a SCSI host adapter. CD-GEN records files in DOS, High Sierra, or ISO9660 format.

• List price: *Philips CDI 350*, \$2,195; *RapidReader CM405ABK*, \$699; *RapidReader CM425ABK*, \$749; *CDD521GN Desktop CD-Recorder System*, \$8,495. *Philips Consumer Electronics Co.*, One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-722-6224.

Circle 410 on reader service card

BRIEFS

MULTIMEDIA

video can be saved as an AVI file, edited, and placed in Windows applications using OLE. PC PrimeTime turns a PC into a TV receiver and allows you to capture still images from 122 channels. It has a built-in tuner and scalable on-screen monitor so you can work and watch TV at the same time. 310-865-1432.

MONITORS AND PROJECTION PANELS

Wyse Technology has announced five new monitors, the 17-inch WY-870 (\$1,149), the 15-inch WY-850 (\$649), the 15-inch, low-emission WY-850ES (\$669), and the 14-inch, low-emission WY-670ES (\$459) and WY-655ES (\$419). The flat-screen WY-870 features a .26 dot pitch, 1,280-by-1,024 noninterlaced resolution, and VESA support. 800-438-9973, 408-473-1200.

NEC Technologies has introduced the MultiSync 3PG (\$3,395), a 27-inch data monitor that is ideal for video teleconferencing, classroom lectures, and multimedia applications. With wireless remote control, you can easily switch from data to video sources, such as VCR or live camera, and the monitor automatically adjusts. 800-366-0476, 708-860-9500.

The Hitachi Group's Nissei Sangyo America Ltd. has unveiled the SuperScan Pro 21 XL (\$3,995), a 21-inch monitor for large-scale, professional applications. It features a flat-screen antiglare screen, a .28 dot pitch, and support for resolutions up to 1,600-by-1,200. The large-scale monitor also supports vertical scanning frequencies of up to 120Hz. 800-441-4832, 617-461-8300.

Datalux Corp. is shipping the Model MLWT (\$1,295) standalone LCD monitor with a built-in touch screen. The physical display, including its folding stand, measures 9.8 by 11.2 by 5.6 inches and weighs about 3.9 pounds. The viewing area measures 9.75 inches diagonally and supports 640-by-480 resolution. The unit can also be wall-mounted for portable presentations. 703-662-1500.

NEW

AMT Ships C-Size Color Plotter

The latest addition to **Advanced Matrix Technology's** Intelli-Plot line of printer/plotters is the Intelli-Plot Turbo II, a 16-color printer/plotter capable of printing on C-size paper at resolutions up to 360-by-360. Using 1MB of RAM and data compression, the Intelli-Plot Turbo II can handle drawings exceeding 5MB, and the internal queue can hold up to 20 drawings. Inside the unit are Hewlett-Packard Graphics Language (HPGL) and AutoCAD Device Interface (ADI) processors, making the Turbo II compatible with leading CAD packages. It also features AMT's Select-Dial technology, which allows you to select from a variety of plot qualities and speeds, automatically scale and rotate drawings, position drawings on the page, save up to five plotter setups, and more. A C-size sheet-feeder and roll-feed option is available.

• List price: *Intelli-Plot Turbo II*, \$1,995. *Advanced Matrix Technology Inc.*, 765 Flynn Rd., Camarillo, CA 93010; 800-992-2264, 805-388-5799; fax, 805-484-5282.

Circle 411 on reader service card

NEW

Speed Up Printing Tasks with SMJ Electronics' Cache Port

SMJ Electronics is of the opinion that throughout the evolution of the PC, little attention has been paid to the parallel port. So they've introduced the Cache Port, an expansion card designed to replace the parallel port and streamline printing tasks by minimizing the CPU time that printing requires. It doesn't increase printing speed or pages per minute, but it does decrease the time you spend waiting to regain control of your PC during a print job. The card comes standard with 1MB of RAM, which will cache 250 pages based on a 4KB-per-page estimate, and can hold up to 16MB of RAM.

SMJ utilizes an exclusive process for off-loading CPU power that moves the pointers that indicate character location rather than actually moving characters within the cache area. No additional software is required to operate the Cache Port, and the card has only two jumpers for configuring the port as LPT1 or LPT2 and selecting the amount of installed memory.

• List price: *Cache Port*, \$449. *SMJ Electronics*, 3500 Clayton Rd., Suite B-200, Concord, CA 94519; 510-918-2450.

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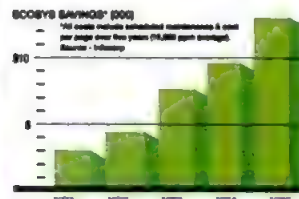
It's official! The unbeatable cost savings, unparalleled productivity and environmental safety of the ECOSYS FS-1500A 10 page per minute network printer has earned it the industry's most coveted awards.

Now, Kyocera introduces another winner:

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PowerMenu Plus 7.0 Runs Programs at Scheduled Times

Brown Bag Software has announced version 7.0 of its DOS-based menu system, **PowerMenu Plus**. The new version can execute menu items at prescheduled times to run programs such as backups and large printing jobs unattended. In addition to launching the application, **PowerMenu Plus 7.0** can actually execute appropriate keystrokes and "wait times" between keystrokes. Also included are file transfer and antivirus programs, plus support for .ZIP files. When **PowerMenu Plus** is installed on a network, supervisors can create group menus for updating several users while modifying menus at the same time.

• List price: **PowerMenu Plus, Version 7.0**, \$49.95. **Brown Bag Software Inc.**, 2155 S. Bascom Ave., #105, Campbell, CA 95008; 800-264-6368, 408-559-4545; fax, 800-264-7638. Circle 413 on reader service card

NEW

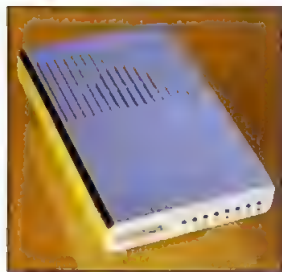
Practical Peripherals Ships Three New Fax Modems

Three new fax modems flesh out **Practical Peripherals'** line, including the **PM14400FXMT**, an external V.32bis modem with 14,400-bps send/receive capabilities. The **PM9600FXMT** is an external V.32 modem with 9,600-bps fax capabilities. Both are designed to fit inconspicuously on the desk, either vertically or horizontally, thanks to their 1.1- by 4.8- by

6.8-inch (HWD) measurements. The third modem is the **PM9600FX**, a half-length, V.32 internal modem card capable of faxing at 9,600 bps. All three are Class 1- and Class 2-compliant and come with **Quick Link II** Fax software. Their built-in features include caller ID and six pages of ROM-based on-line help that shows all the commands you need.

• List price: **PM14400FXMT**, \$399; **PM9600FXMT**, \$329; **PM9600FX**, \$299. **Practical Peripherals**, 375 Conejo Ridge, Thousand Oaks, CA 91361; 805-497-4774; fax, 805-374-7272.

Circle 414 on reader service card



PM14400FXMT's design won't clutter your desktop.

BRIEFS

MONITORS AND PROJECTION PANELS

Polaroid Corp. has introduced the **Polaroid Professional Presenter DP-2000** (\$5,995), a 24-bit active-matrix LCD projection panel for working in DOS and multimedia environments. The panel sits on top of an overhead projector and lets you make computer presentations on a projection screen. With an optional video adapter (\$1,195), the **DP-2000** accepts NTSC, PAL, SECAM, VCR, camcorder, and TV signals. 800-225-1618, 617-577-2000

In Focus Systems is shipping a notebook-size projection panel called the **PanelBook** (\$5,995), which packs a 9.4-inch active-matrix screen, capable of projecting full-motion video, support for 1.4 million simultaneous colors, and a resolution of 640-by-480 in a compact, 2- by 11.5- by 9.5-inch unit. 800-327-7231, 503-692-4968.

CONTACT MANAGEMENT

Information Management Services has announced **ClientWorks, Version 2.0** (\$49.95), a Windows-based contact manager that organizes contacts into groups, dials phone numbers, logs contact dates, keeps unlimited notes, and merges names and addresses with labels, envelopes, and letters. 919-481-9009

Prisma Software Corp.'s **YourWay 3.0** (\$99) is a time and contact management system that runs under Windows and emphasizes customizability. New features include drag-and-drop, a customizable button bar, and the ability to search calendars for appointments, names, or notes about specific meetings. 319-266-7141.

WindoWare! is shipping **Contact!** (\$169), a Windows-based contact manager whose distinguishing feature is its ability to hold great quantities of information about a contact. It features unlimited databases, unlimited records, six names and titles per contact, nine phone numbers with autodialing, and 17 category/code fields on which you can search, all in a single-glance data sheet. 804-886-0116.

NEW

Programmers! Add Imaging To Your Applications

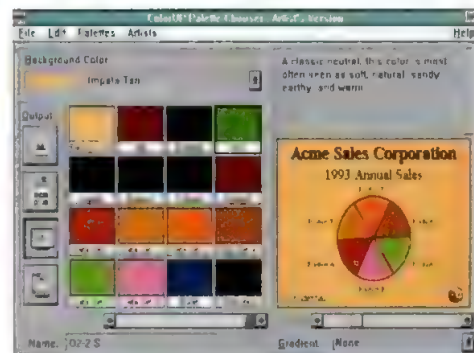
With **Media Cybernetics'** new **HALO Imaging Library** for Windows, programmers can add imaging capabilities to their C applications with more than 100 imaging functions and commands. Functions are divided into groups such as **Image Enhancement Functions** for adjusting and refining brightness, contrast, and gamma characteristics, and enhancing images with effects like blur, emboss, and sculpt. An application program and source code samples are provided.

• List price: **HALO Imaging Library for Windows, Version 1.0**, \$595. **Media Cybernetics Inc.**, 8484 Georgia Ave., Silver Spring, MD 20910; 301-495-3305; fax, 301-495-5964. Circle 415 on reader service card

NEW

Pantone's ColorUP for Windows Adds Pizzazz to Presentations

Pantone has announced **ColorUP for Windows**, a color software management tool for improving the quality and effectiveness of color in your presentation graphics and reports. It comes with a library of color palettes that can be exported into such applications as **Aldus Persuasion**, **Harvard Graphics**, **Lotus's Free-**



ColorUP for Windows enhances presentations.

lance Graphics for Windows, and **Microsoft PowerPoint**. Hundreds of palettes and 120 background colors are available. Also included is the **ColorUP Explorer**, an interactive encyclopedia of color information and experiments that gives you experience in choosing and manipulating colors in your presentations.

• List price: **ColorUP for Windows, Version 1.0**, \$99. **Pantone Inc.**, 55 Knickerbocker Rd., Moonachie, NJ 07074; 800-222-1149, 201-935-5500; fax, 201-896-0242.

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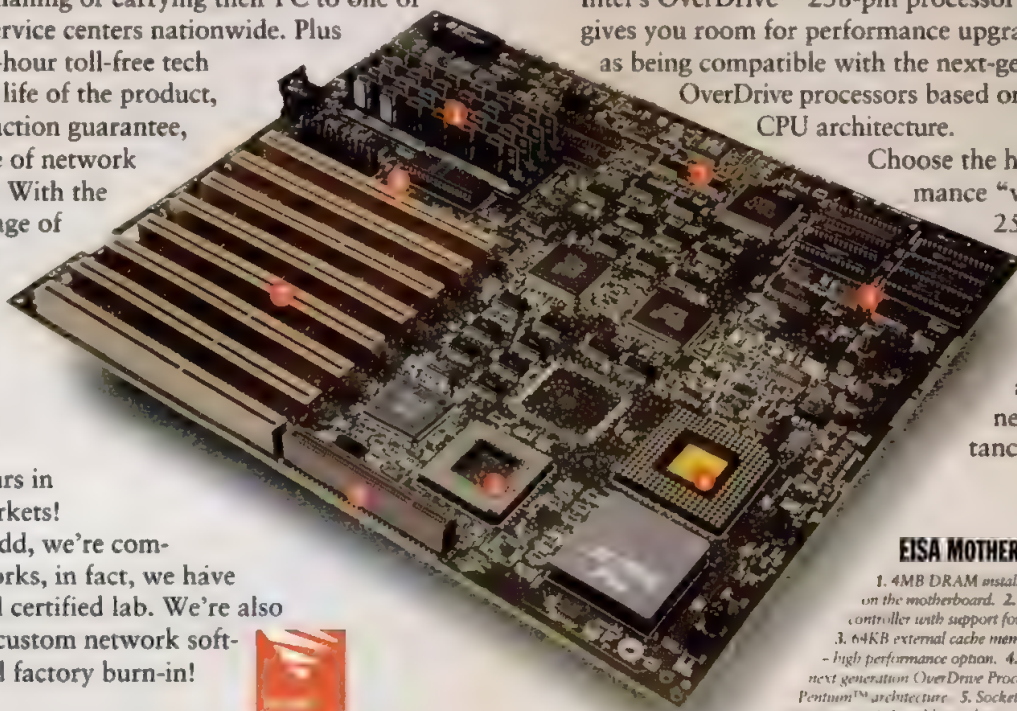
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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Three Assembly Pros Get Back to the Basics

BY RICK AYRE

Pundits have been saying for years that assembly-language programming is a dying art. How then are we to explain the excellent new works on the topic from some of computing's finest technical writers, Jeff Duntemann, Ray Duncan, and Robert Hummel?

First, while it may be true that assembly has only a small place in a world full of icons and dialog boxes, it is an important place. There may be fewer lines of assembly being written, but each one appears at a critical point in a program—a point where performance is crucial. Moreover, understanding assembly language is tantamount to understanding how the computer works. Programming in assembly means living close to the silicon—about as close as mere mortals get. It's exciting to work near the heart of the computer, to feel like the one who is in control.

Second, these writers really like thinking about and programming in assembly. It's clear from the tone of their writing, which they aim at the programmer and general user alike, that they care about the topic. These books are not calculated attempts to turn a profit.

Assembly Language Step-by-Step is a significant upgrade to Duntemann's earlier *Assembly Language from Square One*, an excellent introductory text. Duntemann presents the im-

portant concepts one by one. He then builds on them in a logical, well-crafted way, turning simple concepts into usable subroutines. This is a great way to learn assembly and a superb example of how a beginner's text should present complex material.

This is also a great way to learn about the Intel segmented architecture; first in, first out stacks; and DOS services that are available as software interrupts. While this topic may sound like dry ground, in Duntemann's able hands it is not.

Seldom are we lucky enough to find someone who thinks and writes so clearly on a difficult topic. Duntemann's *Assembly Language Step-by-Step* deserves a place in the programming pantheon, beside Charles Petzold's *Programming Windows* and Duncan's *Advanced MS-DOS Programming*.

Speaking of Duncan, it's good to see he hasn't abandoned assembly. Much of *Power Programming with Microsoft Macro Assembler* has appeared in Duncan's columns here in *PC Magazine*, but most of this material has been revamped since original publication. Moreover, several of the more complicated routines Duncan includes were composed specifically for this book. In short, you'll find much

of *Power Programming* fresh, even if you've read every one of his columns.

Power Programming could well be titled *Advanced MS-DOS, Part 2*. It's presented in the same style as the earlier work: explanations followed by code snippets and fully functional routines that demonstrate how a concept is put to work. Duncan moves quickly from parsing the command line, through accessing sequential files, to programming numeric coprocessors. Duncan's computer

concepts are valuable, even for those who don't ever intend to write a line of code. And they are particularly valuable for those who do; *Power Programming* belongs on the bookshelves of all serious assembly programmers.

Speaking of *PC Magazine*, it's nice to see that the *PC Magazine Lab Notes* series will be edited by someone as knowledgeable as Hummel. Hummel understands this stuff so well it's scary. His book *Assembly Language Lab Notes* examines large topics, such as editing files and mapping memory. As al-

ways, his code is small and tight, awash with a beauty to be both appreciated and emulated. Each chapter begins with a hefty problem and ends with a complete program that pays attention to detail. For example, most of the programs parse the command line, yet each does it somewhat differently because, as Hummel points out, the requirements of each program are different.

Sure, he could have used the same routines over and over, but what's the fun in that? The challenge is to do it properly each time—not just adequately for all time. There is much to learn from a person who thinks and programs like Hummel.

If you never knew that this little corner of the world existed, now is a good time to take a look. Remember, though: Hummel is not the place to start learning assembly. Begin with Duntemann and then proceed to Duncan and Hummel.

As the new object-oriented titles muscle into bookstores' programming sections, the space devoted to assembly language has been gathering more dust than titles. Assembly will never be a hot topic, but it will always be a place of substance. Ask: How many computer books have I read lately that mattered? These three do. □

• **Assembly Language Step-by-Step**, by Jeff Duntemann, \$32.95. John Wiley & Sons Inc., 605 Third Ave., New York, NY 10158, 800-225-5945. ISBN: 0-471-57814-2.

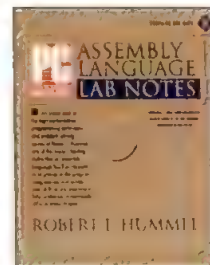
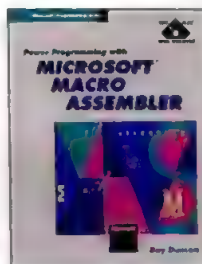
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• **Power Programming with Microsoft Macro Assembler**, by Ray Duncan, \$39.95 (with disk). Microsoft Press, One Microsoft Way, Redmond, WA 98052-6399, 800-677-7377. ISBN: 1-55615-256-6.

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• **PC Magazine Assembly Language Lab Notes**, by Robert L. Hummel, \$29.95 (with disk). Ziff-Davis Press, 5903 Christie Ave., Emeryville, CA 94608; 800-688-0448. ISBN: 1-56276-059-9.

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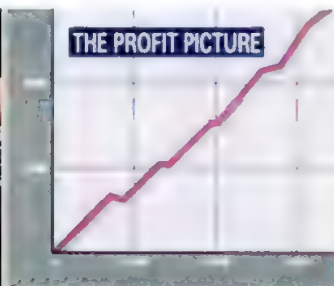


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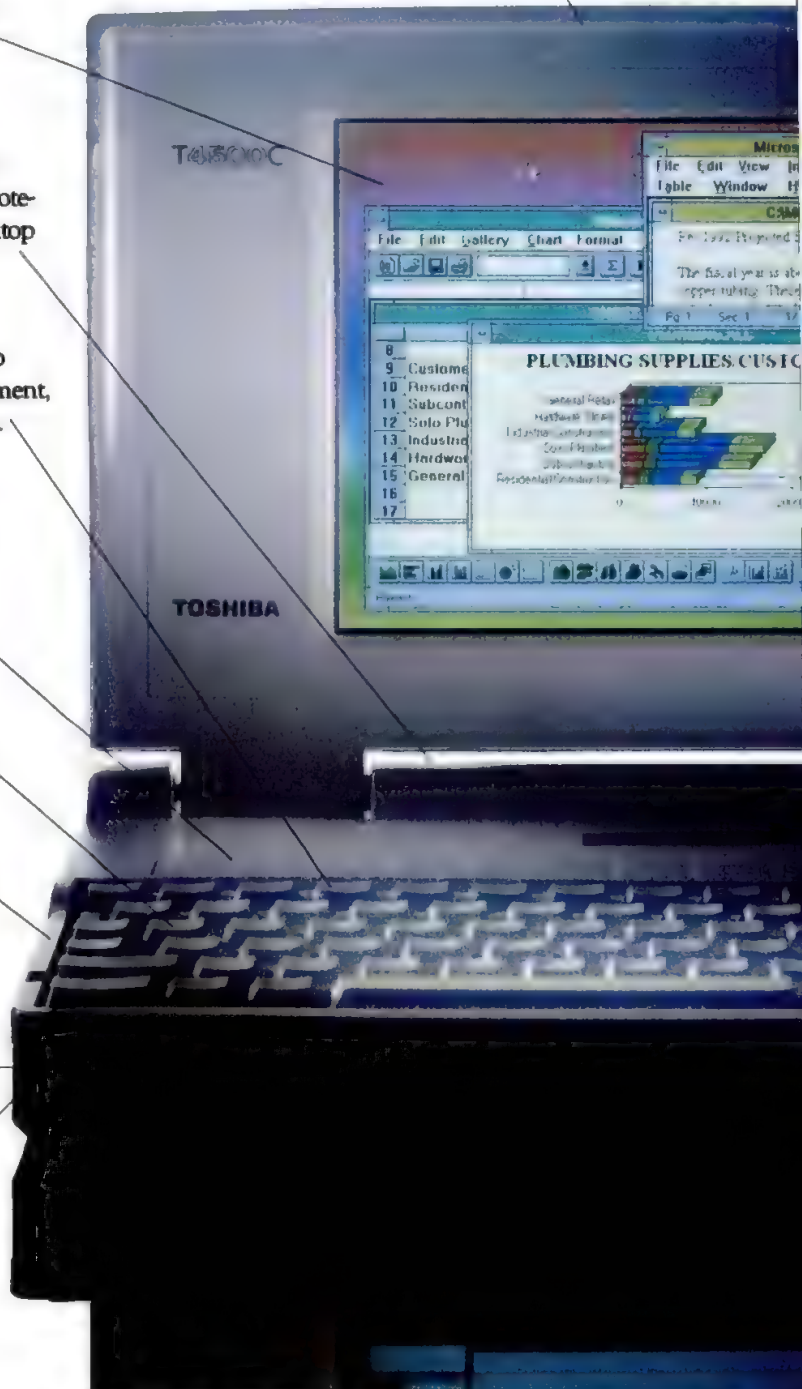
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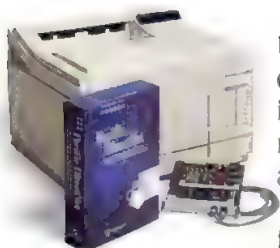
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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

SpyWorks-VB Adds Low-Level Hooks to Visual Basic

BY BARRY SIMON

Visual Basic is a programming environment that insulates you from the complexities of Windows programming—but at a price: There are no low-level hooks. You'll quickly discover that you can't do many of the things you normally do, such as accessing your program's system menu and menus in other programs, setting a program to stay on top of another, or finding out if another program is already running.

If you buy some good books or frequent the Visual Basic (VB) forum on CompuServe, you can learn the secrets of using the Windows API from within Visual Basic. You'll also learn the limits. For example, you can't make API calls that involve callback functions.

Desaware's \$129 SpyWorks-VB releases you from VB's programming straight jacket with its collection of tools. Mind you, SpyWorks-VB isn't for beginners or the fainthearted. You'll need to learn the API functions, master their arcane syntax and the syntax of callbacks, and generally understand what Windows is doing rather than just react to events sent to your controls. You'll also forfeit the protection from horrendous crashes that VB normally gives you.

SpyWorks has four modules plus some debugging tools that are roughly equivalent to the

Spy and HeapWalker programs that come with the Windows SDK. The first module, DWSPYDLL.DLL, contains functions that provide capabilities not in VB and improve access to the Windows API.

The other three components are custom controls: SBC.VBX, the Generic Subclass Control; CBK.VBX, the Generic Callback Control, and SBCKBD.VBX, the Keyboard Hook Control.

Subclassing is the Windows equivalent of chaining an interrupt under DOS, but with two important differences: It is an approved method described in the first 20 pages of the SDK documentation, and it involves all Windows actions—not just hardware operations. By subclassing, you can add menu items to another program and respond to those items when the user picks them! So SpyWorks is ideal for writing add-ons to Windows apps in Visual Basic.

Callbacks are best understood by an example: the EnumWindows API function. One of the parameters passed to this function is the address of a callback function. Windows then repeatedly calls this function, passing it the window handle of each top-level window in turn. The callback function performs a programmer-specified action on the window handle.

You usually can't use API functions that require callbacks, since VB doesn't give you func-

tion addresses. SpyWorks' CBK.VBX control gives you a pool of addresses that can be passed to the Windows API or a DLL for use as callback functions. A simple, drop-down list shows the API callback functions available in SpyWorks.

The keyboard hook can detect any keystroke—even Enter, Ctrl-Break, and Tab—before it is sent to one or all applications.

SpyWorks is a fantastic VB

add-on that lets you write programs that interact with other programs at a low level. You lose VB's protective umbrella, but for many, that will be a price worth paying.

• **SpyWorks-VB, Version 1.0**
List Price: \$129. Requires: *Microsoft Visual Basic for Windows, Version 2.0; Windows, Version 3.1.* Desaware, 5 Town and Country Village, #790, San Jose, CA 95128; 408-377-4770.

Circle 451 on reader service card

Visual Architect Gives VB Spreadsheet Features

BY BARRY SIMON

Often you want an application to accept a set of numbers and perform some simple calculations, such as summing rows and columns. Given that the grid control that ships with Visual Basic 2.0 is often called "spreadsheet-like," you may have assumed it would make such coding easy. But the analogy is only skin deep: The VB grid looks like a spreadsheet, but it lacks spreadsheet functionality.

FarPoint's \$245 Visual Architect is a better spreadsheet control. At the formula level, there are the four arithmetic functions plus powers, block sums, IFs, and PMTs (the standard loan payment function). Besides formulas and the standard data types, cell entries can be buttons or drop-down lists.

Date, time, currency, integer, and real and masked entry custom controls are included. These controls support 3-D effects, and you can add spin but-

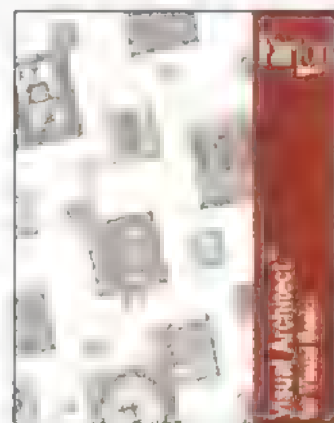
tons where appropriate by merely changing a property. The date in a spreadsheet and the date control both have a very handy feature: If you double-click on them, a calendar pops up. You can also place formulas in the cells of a grid and have your VB application update that cell as data is entered.

Unfortunately, FarPoint's documentation makes learning Visual Architect unnecessarily difficult. It has an elaborate demo and simple, one-line examples, but nothing in between. And the manual lacks an index.

Visual Architect isn't a full-fledged spreadsheet in a custom control. But it does offer basic spreadsheet functionality—which is all most users need. □

• **Visual Architect for Visual Basic** List Price: \$245. Requires: *Microsoft Visual Basic 1.0 or later, Microsoft Windows 3.0 or later.* FarPoint Technologies, P.O. Box 309, Richmond, OH 43944-0309; 614-765-4333.

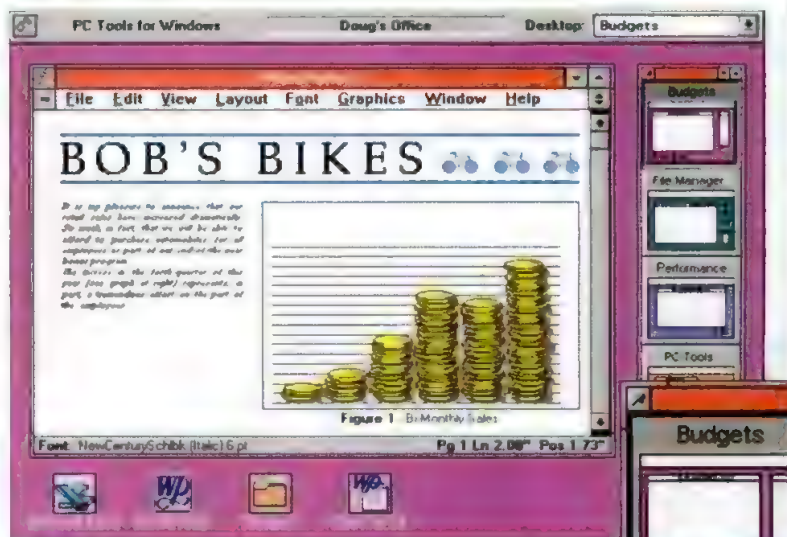
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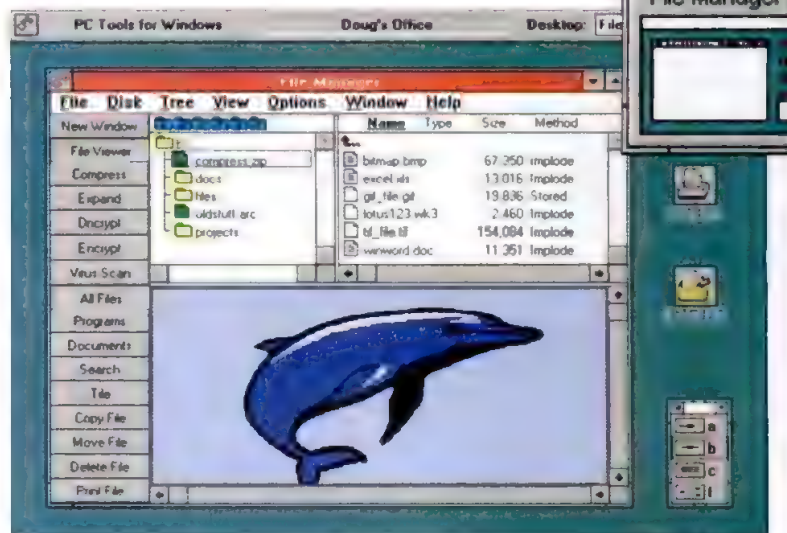
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	Aldus Persuasion v2.1 Windows.....	309
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	Arts & Letters Picture Wizard.....	49
	CA-Cricut Presents (Special).....	109
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	Broderbund Where in the USA.....	29
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	PFS Resume & Job Search Pro.....	39
	Pygnosis Lammings.....	26
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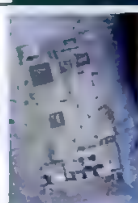
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Michael J. Miller

Are You Connected?

Tune in, turn on, and drop out" were the watchwords of the sixties. "Plug in, dial up, and log on" may be the mantra for the nineties when internetworking and wide-area networks will change our business lives—and, very possibly, our personal

lives—in ways that the PC revolution only foreshadowed. We'll have access to more information at our desktops. We'll be able to share messages with more people. We'll be able to work together more smoothly and more efficiently with people in our offices and with people who are far away. And we'll be able to access local, company, and global databases.

Once upon a time, you had a PC and maybe a 300-bps modem. Now, you're likely to have a 9,600-bps or 14.4-Kbps modem, if not something more exotic. We used to talk about the day LANs would become common. Now we're concerned with linking LANs together.

Chances are good that you are connected and that you're relying on the connections more today than ever before. New technologies, new standards, and most importantly, new applications are making networks common. The old ad used to say, "The network is the computer." That's true today more than ever.

Many trends are converging to make networking inevitable. The price of networking has declined dramatically, with lower-cost Ethernet and Token-Ring chip sets appearing on motherboards, in low-cost adapters, and even in tiny portable network adapters. Networking has also become much easier to implement. Microsoft Windows for Workgroups, Artisoft's LANtastic, and Coactive Computing's new external LAN adapters and software make setting up a simple network much easier. And new generations of hubs and routers make connecting these networks easier still. Finally, software developers are realizing that many of their customers are networked, and that they had better take advantage of it.

Until recently, networks were used just for shared printing, maybe a

little electronic mail, and perhaps a multiuser database. In the next year or two, though, networking features should become commonplace. Spreadsheets are offering features that enable different people to update different worksheets or even different ranges of cells, then consolidate and track the information. Word processing and desktop publishing packages are gaining version control and comparison features, and many programs allow multiple users to add notes and comments.

GROUPWARE

This new generation of software allows people to create, track, communicate, and share data within a broadly defined workgroup. Such groupware can be all-in-one packages such as Lotus Notes or combinations of packages, such as forms routing packages attached to electronic mail.

All sorts of tasks fall within the groupware framework. Data creation features include forms design, data creation, data translation, and reporting. Data management features include information retrieval, archiving, and version control and tracking. Communications features range from sending electronic mail, to conferencing,

to routing messages to the proper people, to acting as a front-end or gateway to other systems. Data-sharing features range from shared databases to group scheduling packages to methods of managing collaborative documents.

Although no one package does all of this, few users really need all of these features. So we turn to combinations of packages that together offer a wide variety of features.

At the same time, the client/server model of database computing is beginning to move down



Internetworks and wide-area networks are the buzzwords of the day. What promises do they hold?

Michael J. Miller

from larger systems on to PC-based servers. This trend started a long time ago with packages such as Oracle, Gupta's SQLBASE, and Microsoft's and Sybase's SQL Server, but it looks like this category is picking up some steam.

Client/server computing is becoming more accepted on the PC because there are now better front-end tools for using SQL data, ranging from graphical database front ends, to executive information systems, to better spreadsheet access. In part, this is driven by new standards for accessing SQL data, such as Microsoft's ODBC, Oracle's Glue, and Borland's and others' IDAPI. The client/server model may well get a push from more robust network operating systems, such as network systems based on OS/2 2.1, Windows NT, and Netware 4.0.

The push toward groupware and client/server computing will increase the amount of data moving over our networks, but not nearly as much as the move toward multimedia. We're now seeing methods of mov-

ing animation, sound, and video over a LAN. We're not only integrating fax and scanned images, but AT&T and Novell recently issued a statement of intent to integrate telephone PBXs with LANs. After all, telephone conversations are just another form of data. All of this will significantly increase network requirements. Currently, just a few people moving video clips between a central server and workstations will bring most networks to their knees.

The volume of activity over the network is also increasing as a result of the growing popularity of mobile computing. We need our network information even when we're disconnected, at home or in a hotel room. Dial-up lines going into network modems or peripheral routers offer some solutions. So does the emerging class of peripheral routers that lets you dial-up and connect.

THE BANDWIDTH BLUES

Remote access, new groupware applications, and multimedia applications such as imaging and document management all demand speed—speed of the networks both within a building and across sites. This need for increased bandwidth can be quite expensive. It conflicts with the investment

we've all already made in our current networks and in the current phone system.

But there are promising signs. Structured wiring systems inside buildings will allow theoretical speed of up to 100 megabits per second and provide the infrastructure for easily installing and maintaining networks. Networks can be connected through relatively inexpensive multiport switches that work from 300 kilobits per second to 8Mbps. Between sites, more and more phone companies are offering switched digital services, such as 56-Kbps lines and ISDN (Integrated Services Digital Network) connections (twin 64-Kbps lines). Currently, the price and availability of such services vary widely in different locations, but over the next two years, you can expect the cost of ISDN and other switched services to drop significantly, as local phone companies install equipment at their central switching offices.

The result is a great increase in speed, without the need to replace the copper lines in our homes and offices. Fiber-optic cables to the curb and copper to the desktop should give us the speed needed to run the next generation of software from wherever we are—just plug in, dial up, and log on. □



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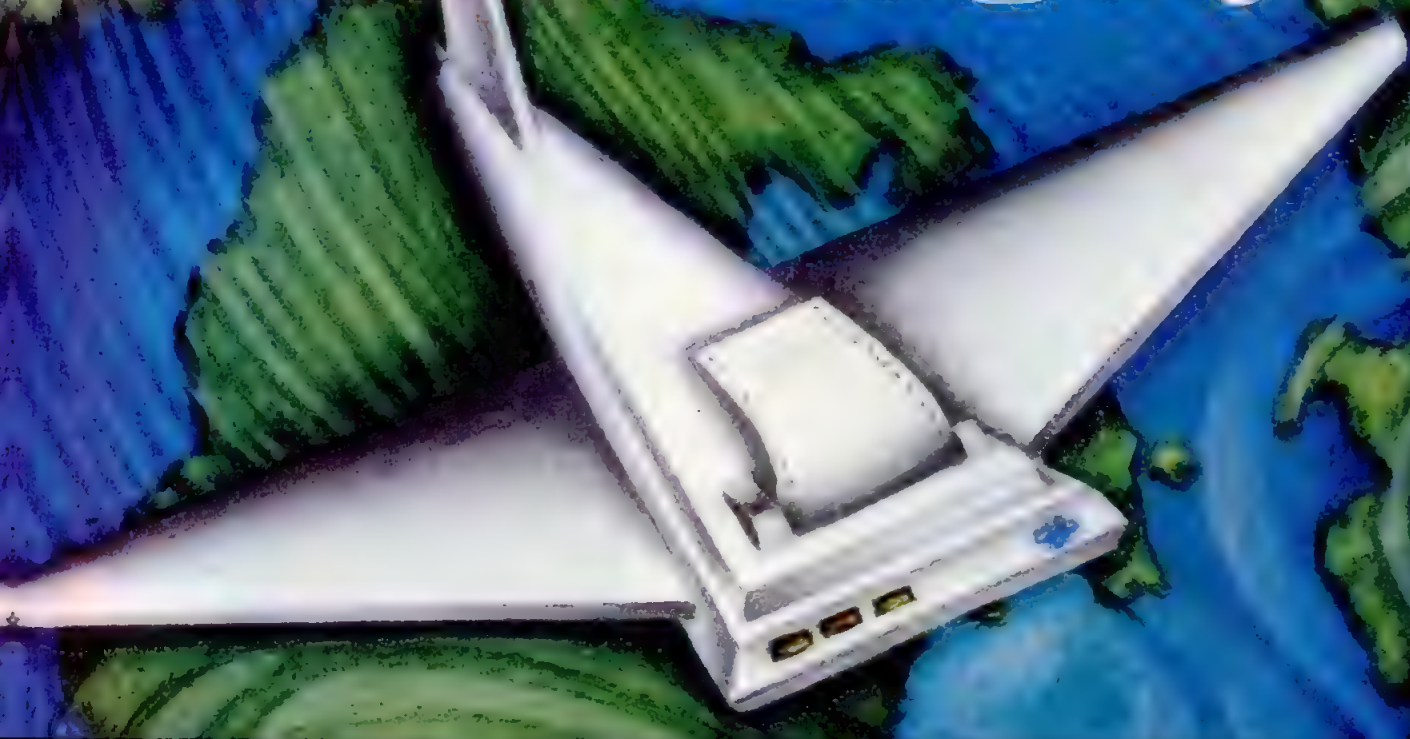
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Bill Machrone

Hi, It's Me!

I've just gotten into a rental car. Barely. The seat is so close to the steering wheel that entry was a feat of contortionism. One mirror is pointed skyward. The other assures me that objects on the ground next to the car are closer than they appear.

The selections programmed into the radio alternate between static and headbanger "music." Grumbling about such inconveniences is a prerequisite for proper business travel.

I voice my complaints to my business associate, and tell him that rental cars should have a card reader in the dash. I could just pop in my Gold Card and the car would know how to adjust the seat, mirrors, and radio, even the temperature. "Why a Gold Card? Why stop at the car?" he asks.

Why, indeed. Suddenly it strikes me that what I really need is a PCMCIA card with multiple megabytes of storage. Not only could it hold a trove of information for customizing the devices around us, but it could be an extensive personal database, too. Most of the time, it would live in a subnotebook or palmtop, pocket-size computer. It would venture out to interact with intelligent devices in the real world.

Let's revisit that car for a moment. Maybe having a rental car adjust itself to you is frippery, but I can think of many ways that the family wheels could be improved with an infusion of intelligence. Your kid pops his MasterMem into the dashboard socket. Recognizing that he's 17, the system allots him (at your behest) 60 percent of the engine's available performance and a top speed of, say, 70 mph. Without the card, the car is configured for valet parking: slow acceleration and a top speed of 30 mph. With this setup, Ferris Bueller's friend would have had nothing to worry about.

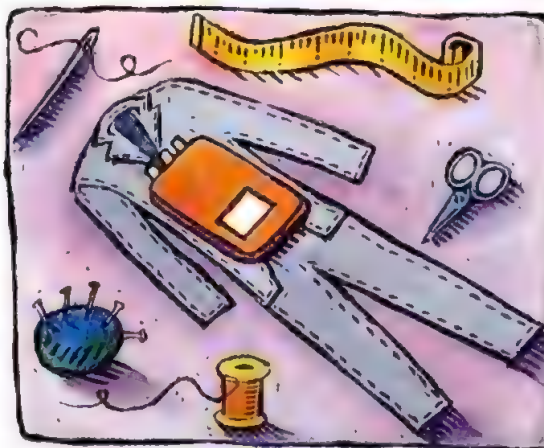
Then there's that other great convenience: the cellular phone. When you're on a business trip and the calls are stacking up, a rental cellular phone is indispensable. Imagine how

convenient it would be if your personal database loaded it with names and numbers. Imagine how quickly you could do your expense reports if the card kept track of the charges and dumped them right into your PC.

Laptop computers are still at the bottommost rungs of the ladder that leads to a revolution in the way we do business. As the machines get smaller, grow in capacity, and we commit more data to them, we'll be more dependent on them. Beyond notes and calendars and to-do lists, tomorrow's portable computers will carry a lot of sensitive information. You might have personal information, departmental budgets, employee records. Losing your machine could be a disaster. A PCMCIA card could hold the most sensitive information or provide the encryption key that keeps prying eyes out. Of course, we'd have to develop a new discipline of removing the card from the machine when we weren't using it. We may bemoan the loss of innocence, but there may come a day when you would no more leave an unsecured computer running on your desk than you would leave your car running while you went shopping.

Desktop and building security is another important

task that could be given over to your personal PCMCIA card. Granted, it would be inconvenient to pop the card into a socket every time you wanted to go through a door, so you'd need a low-powered wireless link between your pocket machine and the security system. Once you go wireless, you don't even have to plug into your desktop system—you just have to be in the same room. With a little imagination, you can see your system coming to life as you enter the room and bringing new e-mail and phone messages to your attention.



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Bill Machrone

GETTING PERSONAL

Personal finance is the bane of almost everyone's existence. When PCs first came on the scene, every salesperson's litany included a chauvinistic line to win over the dubious spouse: "... and your wife can put her recipes on it, and balance the check-book." Of course, nobody did either. Quicken nullified many of the objections to the drudgery of bill paying, but it still required you to sit down at the computer and enter all those checks you wrote at the dry cleaner's and the food store. A terrific new gadget from Panasonic called the CPA promises to change all that. It's the size and shape of your checkbook, with an LCD window and some keys. You press a few buttons, key-in an amount, and it starts buzzing and zapping. Next thing you know, a freshly printed check emerges from the side of the unit. You can key-in deposits, set up payees and payment categories, and keep a running total of expenditures. It outputs a Quicken-compatible file through a tiny serial adapter plug, so your computer can find out what checks you've written while you're out and about. Forget the hype; this is the first personal digital assistant, single-purpose though it may be.

A personal data card could enhance this wonderful device even more. You could walk up to an ATM, transfer money from savings to checking, and have the ATM write the amount into your card. You slap it into your checkwriter-PDA and shop till you drop. Then you slip the card into your desktop machine and it merges your checkwriting files (desktop and pocket) so that you always know where you stand.

With so much riding on one little card, losing it could put a crimp in your activities. Since it's only data, however, replicating it or rebuilding it from backup systems would be a simple task. Given that it would contain much confidential data, the security would have to be pretty good. Fortunately, today's data encryption standards are up to the job. With a DES-style public-key/private-key encryption scheme, a lost card would keep its secrets safe from prying eyes. The design could even include physical security features that erase the card if someone attempts forcible entry.

The best part of all this is that we have most of the technology to do it today. All we really need is a set of rules and a little market research. The rest is in the cards. □

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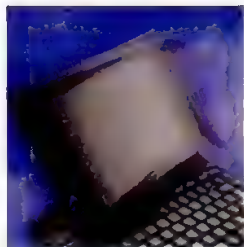
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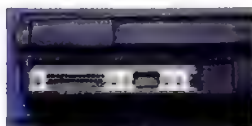
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CIRCLE 038 ON READER SERVICE CARD





John C. Dvorak

More Bonehead Marketing

In January 1992, a French company attempted to launch a Minitel service in the San Francisco Bay Area called 101 Online. You never read about it in *PC Magazine* because the marketers believed that PC users should be bypassed, ignored, snubbed.

"This is a service for the people, not for the elite," I was told when the service began.

Minitel was established in France to replace all phone books with an on-line, up-to-the-minute phone directory service. The terminals were given for free to the public. Services such as on-line shopping, e-mail, and plane reservation systems were installed. To date over 17,000 services are offered in France, with most available through a gateway in the U.S.

The system had great potential here, especially at the \$9.95-a-month flat service charge. No dice, though. I wasn't surprised to read this report about 101 Online late last year in *Communications Daily*.

"But we were told that despite massive expenditures of about \$1 million for startup, the service, as partners designed it, never caught on. Only about 600 customers signed up. By late summer, the company had laid off most of its staff of 20, leaving only a half-dozen workers to keep business going while partners tried to determine whether to continue and, if so, in what direction. Sources said some problems stemmed from inordinately high expectations, with the company believing it could succeed almost immediately, putting on minimal promotional and advertising efforts while maintaining expensive offices in downtown San Francisco." Crummy computerized BBSs run by eighth graders are more successful.

This marketing concept—ignoring the influence peddlers and going straight to the masses—is foolhardy and neglects the simplest lessons of sociology. New technologies gain acceptance through the trickle-down phenomenon—influence from the top. It's not the magazines that are the influence peddlers, it's the readers of the

magazines. The readers are a core collective of a few million people who make and break concepts and products. It acts as a filter for ideas and trends. Like an organism—a superorganic in the cultural anthropological sense—it picks and chooses the winners and the losers. The public follows suit.

As far as 101 Online was concerned, these people didn't mean squat. The marketing geniuses decided to bypass the technological intelligentsia and sell directly to the skittish public. Interesting concept. To my way of thinking, its market consisted of the dingbats who watch the Psychic Friends Network infomercials and actually believe them! That would be fine if 101 Online were selling Tarot readings, but it wasn't.

Simply put, because of an imperious disdain for the knowledgeable computer user, 101 Online has been one of the biggest, most laughable flops in recent memory when it could have been more successful than Prodigy.

From my perspective, 101 Online was a bonehead operation. It was obvious when I first spoke to these guys that they had no interest whatsoever in making the Minitel link available to computer users. The dinky

little Minitel terminal was needed. There would be no discussion. Personally, if I could link to the French system, it would be worthwhile if for no other reason than to make hotel reservations and get weather reports.

Still, doggedly and arrogantly ignoring computer users, 101 Online lingers and is attempting to move into the educational arena. Meanwhile, US West has linked up with Minitel to promote a service in some western test areas. One of these days, someone will get it right. But *not* by idiotically snubbing computer users.



How one company bungled a huge opportunity to open a European on-line service to PC users in the U.S.

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January 12, 1993

—PC Magazine
November 24, 1992

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CIRCLE 217 ON READER SERVICE CARD

Inside Track

By the time you read this, IBM should have a new CEO and should be renewing its participation in the small computer arena instead of clinging to **old traditions** and old machines as was the case during the Akers era. Talking to IBMers nowadays reveals a lot of **bitter** anti-Akers sentiment. One long-time innovator at the company said that Akers' problem was that he would have nothing to do with anything involving the "V" word. V meant vision.

Things at IBM **deteriorated** to the point where there was **open rebellion** among the younger getters who were having one innovation after another shelved so the company could focus attention on the AS400 business. The rebellion surfaced at last year's Comdex when a group developing IBM's "**Green**" computer bypassed the normal press process and showed the environmentally upbeat machine to the media. The press notice forced IBM to bring it to Comdex where it **won a Comdex "Best Of Show" award**. Apparently, factions inside IBM were embarrassed by this positive publicity!

IBM also seems **stunned** by the resounding success of its 700C color laptop, the **single hottest product** in the laptop arena. One key to the success of the machine is the unique TrackPoint mouse substitute. It's a red nub in the middle of the computer that is an amazing mouse/trackball substitute. I'm told that **this invention had been sitting on the shelf since 1988**, and a couple of young turks at IBM had to fight to get the company to use the invention. Another hot prospect sitting on a shelf is a device called Leapfrog, which is also being **secretly shown** to the press against the wishes of the IBM press office. Apparently, it's an ultrathin pen-based power computer that uses a full color active-matrix LCD unit. Shazam!

This all reminds me of the stories I was told by some ex-IBMers about the **killer backlit laptop/portable machine** that was **mysteriously shelved** for the **doggy IBM Convertible** years back. It makes you wonder what the heck was going on. Why was there so much emphasis on a dead-end like the AS400? Why the short-term thinking? And **why drop the ball** when you have a research facility that is second to none in the entire world?

From all accounts, Akers was not a bad person. Rumor had it that he was **very depressed** when he turned in his resignation. One story going around the

*IBM has some amazing
new technologies in its
backrooms—smaller,
faster, cheaper stuff
done by the unsung
young hotshots. Fast
chips, hot networks, and
cool hardware are the
future, and IBM has it.*

company is that once the stock plummeted after the **record loss** (the most for any business for one quarter in the **history of humanity!**), the board finally took action. Apparently, Akers didn't measure up to his own performance edicts. This resignation was **obviously not voluntary**, or he would have done it long before this mess.

Within a week of Akers' ouster, rumors started to fly about his **replacement**. Topping the list was **John Sculley** of Apple, rumored to have been **offered a fortune** to take over IBM and lead it into the twenty-first century. I figured Sculley would be a fool not to take the job. It would offer him the opportunity to **squash Microsoft**, something he wants to do after his

past humiliation at the hands of the wily Bill Gates. Gates, you recall (see Sculley's biography, *Odyssey*), intimidated Sculley during the early days of the Mac, then walked off laughing with Mac customers. Also, the CEO of IBM holds one of the world's most prestigious jobs. This would make up for the snubbing of Sculley (and almost every other business leader in the country) when President Clinton chose **know-nothing** political hack Ron Brown as commerce secretary.

Next on the short list for CEO at IBM was **Jim Cannavino**, **adored** by the young turks at IBM and one of the few internal guys with a good shot at making the company viable again. Cannavino has a true view of IBM and knows which **stooges, boneheads, and featherbedders** should be removed. But the board indicated it wanted an "outside-insider," whatever that is. Many employees were **rooting for Ross Perot**, an ex-IBMer. These are probably the same people who voted for him. But Perot is hardly an outside-insider anymore, except for the fact that he bought into Steve Jobs' company, NeXT. It would be amusing if Perot were hired and he brought in Jobs as his right-hand man. Jobs also has a **grudge against Bill Gates**, but I think Jobs has a grudge against everyone by now.

IBM will be in the hands of the new CEO. The future of **IBM is tied to OS/2** and its work with Apple. IBM canned its supercomputer division and is against the wall with useless mainframes. The AS400 is a slug, a joke. On the positive side, its new amazing backroom technologies are all smaller, faster, cheaper, stuff done by the **unsung young hotshots** who like working at IBM. Fast chips, hot networks, cool hardware. That's the future and IBM has it. OS/2 is loved by these aggressive kids, these punks who developed all this cool stuff.

Maybe it really is a **new IBM**. I hope so. □



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Jim Seymour

When Works Packages Work

I've never thought much of "Works"-style packages. They fail even the 80/20 test on functionality, and they typically offer sloppy integration, though functionality and integration capabilities are their two most-advertised benefits.

But I'm beginning to change my mind.

The earliest Works packages for DOS at least staked out interesting territory. Ignoring the limited success of high-end integrated software packages such as Symphony, Enable, Ability, and Framework, Microsoft Works went for the opposite end of the market: computer neophytes and casual PC users who were price sensitive and not very demanding—and didn't know what they were missing.

The DOS versions of Microsoft's Works package aren't very impressive. Alpha Software, better known for macro packages, created a winner in AlphaWorks, but it didn't get much attention. AlphaWorks was eventually sold to Lotus and emerged as LotusWorks.

A WORKING STARTER KIT

In its current Version 3.0 incarnation, LotusWorks is a pretty good starter kit for new computer users and can also form a decent and economical software kit for very basic notebook and subnotebook PCs. But Lotus has shown repeatedly that it neither cares much about low-priced products nor knows how to sell them, so you may not find it on many dealers' shelves.

The dirty little secret behind many Works packages is that they were never intended to be retail products sold to individual PC users. Rather, they were meant to be used as bundled promotional goods. Software vendors such as Alpha tried to get at least some retail sales in order to legitimize the packages' supposed \$200-\$300 retail price, but the real goal was to get hardware vendors to license them (often for as little as \$10 a copy) to bundle with their computers.

With those economics,

Works packages were unlikely to achieve the power and finesse of individual, full-function applications. But I've been changing my mind about them lately. Two changes have turned these jack-of-all-trades-but-master-of-none packages into interesting alternatives to conventional single-function programs.

First, as with so many areas of the PC business, was the rise of Microsoft Windows. Windows itself finally delivers the applications integration that Works packages always promised, offering both a consistent menu interface from application to application and the ability to share data between applications.

And at least some vendors are taking Works packages more seriously in the Windows era. Microsoft's own Works for Windows, Version 2.0, for example, is a really nice piece of work. While no one will mistake it for Microsoft Excel or Microsoft Word, Windows Works offers remarkably good functionality without losing that ease of use that attracts so many new PC users to this category.

What I like best about Windows Works is how well it does the things most people really need: letters, reports, and mailing lists. It

also features excellent mail-merging capabilities. Microsoft has made good use, once again, of its "Wizards," an interactive system that guides users through common but potentially confusing tasks.

Especially for the lucrative small-office/home-office (SOHO) market, Windows Works is a fine choice. (But please, Mr. Gates: How about a decent communications module? DOS Works has one. Surely you don't think anyone uses Terminal, that doggy comm program in Windows.)

The second change in



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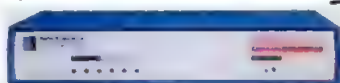
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Jim Seymour

Works products that is changing my mind is the emergence of broader, toolkit-style packages, exemplified by Micrografx's new all-in-one Graphics Works package.

I've never understood why PC drawing programs sell as well as they do. CorelDRAW, for example, is a big seller, yet relatively few PC users—and certainly very few business PC users—need or use drawing software. And when they do, what they need isn't a rich stew of professional-level tools, such as those provided by Corel, but a simpler and more diverse graphics toolkit.

Enter Graphics Works. Micrografx has bundled in one box fine drawing and photo-editing applications, a pretty good slide show, a fair charting and graphing program, and a huge pile of good clip art and very good stock photos—all native Windows products—for a street price under \$200.

JUST WHAT YOU NEEDED

These programs may not in every case be the very best of breed for their type, but they're very good—and better than what most of us need. You could spend well over \$1,000 assembling a similar toolkit from other vendors' offerings and not come up with the value Micrografx puts in this box.

It's widely known that Micrografx has travelled a rocky road lately, and it may well be that Graphics Works would not have come to market if the company had not been looking for a way to wring quick cash out of some of its slower-selling programs. But that's not important; what is important is that for the first time we have a does-it-all graphics toolkit from a major vendor, at a price that makes it a sensible choice for the occasional graphics user.

Graphics Works may even help gain Works packages some attention and respect from the higher-end PC users who have long disdained them. ("Sure, I recommend them for friends buying their first computers, but there's nothing in them for me.")

Even if you routinely use programs in the Excel, Ami Pro, or Paradox/Windows class, you'll find Graphics Works a good fit. And if you've been wanting to do a little graphics-dabbling—creating a logo, touching up a scanned photo, or perhaps creating your first PC slide show—you'll be especially knocked out by it.

Windows Works and Graphics Works prove that Works packages no longer serve only as cheap bundles for beginners. □

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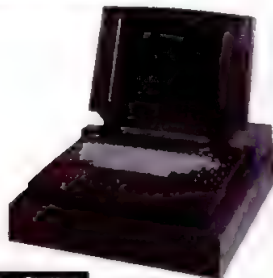
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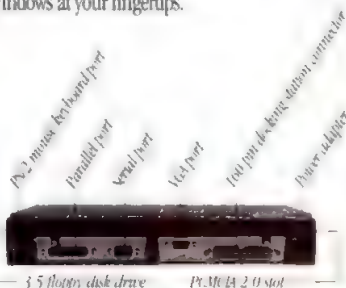
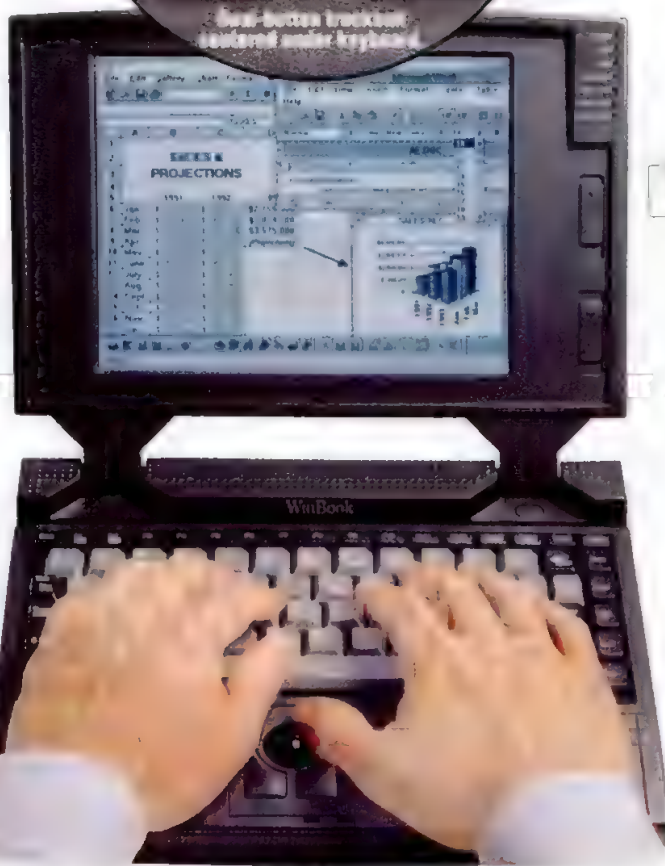
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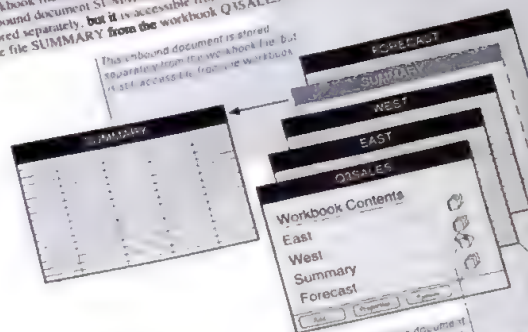
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Managing Documents with Workbooks

Organizing your Microsoft Excel documents into workbooks makes it easy to manage your document files and keep related information together. By opening or closing a single workbook document, you can open or close all of the documents you need for a specific task.

A workbook is a type of Microsoft Excel document in which you store other documents or information about other documents. A document stored in a workbook file is *bound* in the workbook. An *unbound* document appears in a workbook's list of documents, but the document file itself is stored outside the workbook file.

The following illustration shows bound documents and an unbound document of a workbook file. The bound documents are stored in the workbook file Q1SALES. The unbound document SUMMARY, however, is not stored in the workbook file. It is stored separately, but it is accessible from the workbook. That is, you could work with the file SUMMARY from the workbook Q1SALES.



While bound documents such as EAST can be bound in only one workbook, unbound documents such as SUMMARY can appear unbound in several workbooks at a time.

Excel's Workbook is great for anyone considering going back to school. You get a whole new set of rules to learn.

e Excel's Workbook D have a lot to learn.

The first thing they'll have to learn is an extensive set of new commands and procedures.

Because unlike 1-2-3's 3-D, which lets you work just like you do in 1-2-3's 2-D, Excel's Workbook has a whole new set of rules.

The second thing they'll learn is that Microsoft® Excel doesn't really have 3-D architecture. Instead, it takes separate 2-D worksheets, each saved separately in its own file, links them and stores them together in what they call a Workbook.

1-2-3's true 3-D architecture, on the other hand, actually lets you work multiple worksheets, tightly integrated, in one file.

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2-D can look like 3-D, but...

It doesn't take long to learn what you're giving up.

Because Excel's 2-D worksheets are each in their own file, it's more difficult to work with them together.

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off every time you move to another sheet.

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While 1-2-3 users can graph 3-D data in one step, Excel users can't.

While 1-2-3 users can create 3-way what-if tables, Excel users are limited to 2-way tables.

And while 1-2-3 is fully compatible with 1-2-3 for DOS 3-D files, Excel is not.

Compared to true 3-D, Excel's Workbook process is invariably more complex, less intuitive, more work intensive, and because everything is done through data links, slower.

In fact, it can take Excel 10 times longer than 1-2-3 to recalculate a multisheet file.

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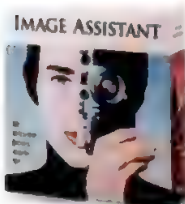
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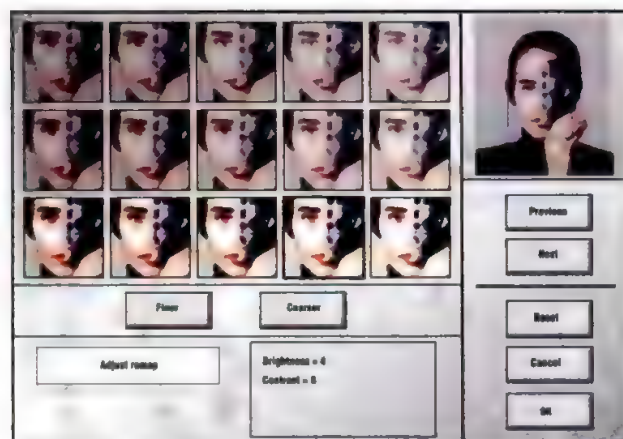
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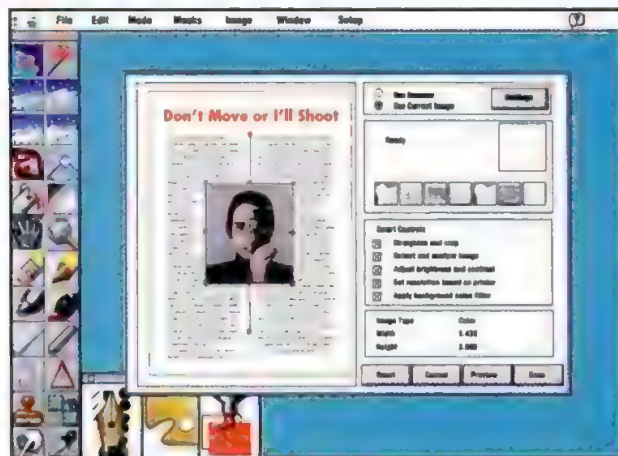
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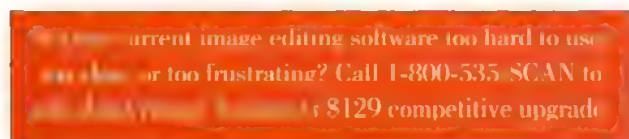
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Bill Howard

Price Wars: Still Simmering

When it comes to price, PCs are like real estate. We worry about whether we bought at the right time. In the case of real estate, the question is: "Are prices about to go up in a hurry (should I buy)?" With computers, it's: "Are prices about

to go down in a hurry (should I wait)?"

Someone who deferred a PC purchase by three months last year was rewarded with as much as a 20 percent savings. Over the course of 1992, selling prices declined by about a third. A 486DX/33 system that began the year at \$3,000 ended at \$2,000. Here are four thoughts on where prices are headed.

First, prices will continue to decline, but nothing like the 1992 free-fall—probably 15 to 20 percent this year. Second, the price the vendor collects per sale will remain the same or increase as buyers specify better-equipped systems. You're likely to buy a system with 8 or 16MB RAM instead of 4MB, a 200 or 340MB drive instead of 120MB, and a 15- or 17-inch monitor instead of 14 inches. You might even add a CD-ROM drive.

Third, while some PC vendors will suffer reversals and even exit the business, it's wishful thinking to predict that the market a year from now will look like the automobile industry, with only a dozen players.

Finally, lower PC prices are slowly killing DOS and DOS applications. Every computer that's sold this year is fully capable of running Windows or OS/2. Once buyers have Windows-capable PCs, they're likely to try, and stick with, Windows.

The first three points are important for you now. The last point may be most important over the long haul—especially to software vendors slow to make the switch from DOS to Windows apps. PC prices fell so sharply in 1992 because CPUs, memory, hard disks, and motherboards got cheaper. That will continue this year. But as high-performance systems approach the \$1,000 mark, the power supply, the keyboard, and the chassis make up a greater fraction

of price. There are no revolutionary manufacturing techniques that can shave one-third off the cost of a \$100 power supply every year.

Prices also appeared to fall because of a pair of one-time events. Major vendors, tired of direct-channel upstarts who compared mail-order selling prices to discountable retail-channel list prices, knocked as much as 25 percentage points off their dealer discounts. This effectively reduced the advertised price of a \$3,000 system to \$2,000—though the customer paid the same price. Second, value-line PCs brought the price of an entry-level system unit from an IBM or Compaq down from \$2,000 to \$1,000.

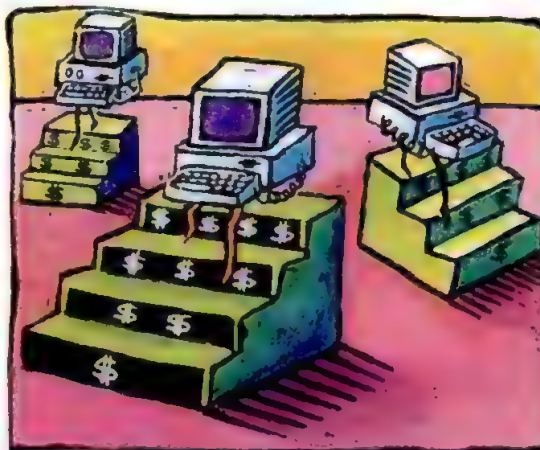
NICE PRICE IF YOU CAN GET IT

The high price of CPUs may temporarily prop up prices. The faster chips in each processor category are hard to come by and carry a gray market premium. For instance, Intel quotes the price on its 486SX/33 chip at a bit under \$200, but some smaller vendors tell us they're paying middlemen a \$100 premium on top of that.

So what's your best bet? If you want the best deal

on a hyper-fast PC, you may want to lower your sights from a 66-MHz 486DX2 to one running at 50 MHz. In the low- to mid-range, if you're not hung up on the Intel brand name or the 486 moniker, you'll find an AMD 386/40 runs roughly as fast as an Intel 486SX/25.

Prices will continue to slide; many PC vendors, from IBM and Compaq to the little box-assemblers that crank out 250 units a month, believe that if they can drop prices further and ride out a few more months of rough times, they'll survive. Take advantage. □



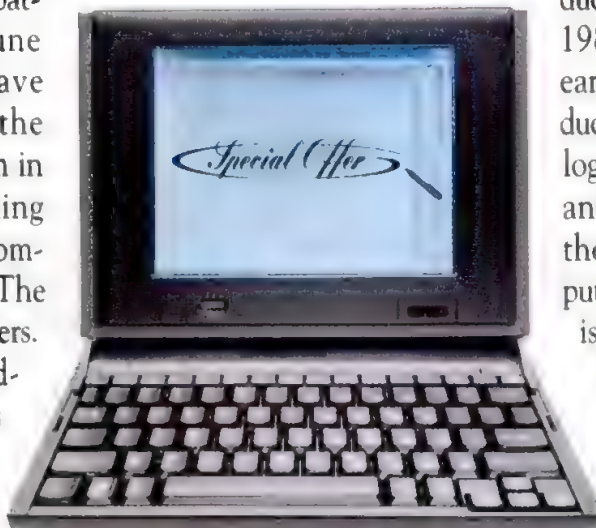
The biggest battles may be over, but the PC price wars will keep some of their momentum.

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DOS 6

The Ultimate Software Bundle?

by Jeff Proise

Disk compression, memory management, file backup, virus protection—DOS has evolved to handle today's toughest computing challenges, but while Microsoft sets a new standard, power users will always want more.

DOS 6 is a fine example of Software Darwinism—software that has adapted, the best it could, to keep up with the times. Nothing in DOS 6 is particularly revolutionary; there are no showstopping technological breakthroughs. The 1MB barrier is still firmly in place.

Nonetheless, DOS 6 is vitally important for two reasons. First, through a series of minor additions and modifications, it competently answers a sizable portion of customer complaints about previous omissions and shortcomings. Second, and perhaps more important, it builds into the operating system many of the utilities on which we've come to depend. Built-in disk compression, memory management, file backup, and virus protection are the meat of this DOS revision. Considering the upgrade's \$129.95 price tag

(\$49.99 until May 31), you might be hard-pressed to match the same bang for the buck in any third-party software combination. But how do the DOS 6 utilities stack up against similar offerings from software makers? In this story, we compare DOS 6 to the leading third-party products in six important utility categories: disk compression, memory management, file backup, virus protection, disk caching and defragging, and configuration management. We also let *PC Magazine's* experts tell you what's still missing from DOS, as well as provide a list of tips to get you started.

The bottom line is that DOS 6 will make life easier for many users. Compression will be as simple as typing "DBLSPACE." Optimizing memory will require nothing more than entering "MEMMAKER." And because they are more accessible, these features will be used more than they've been in the past. Still,



power users who want to be out on the cutting edge, squeezing every bit of oomph from their operating systems, may find this release a bit tame. Remember, too, that MS-DOS 6 is sold only as an upgrade kit so you'll need to have an operating system already on your PC. And since Microsoft is licensing several flavors of DOS 6 to PC vendors, the version that comes with a new machine may not include the full suite of utilities. Here's a look at the major enhancements.

EXPANDING DISK SPACE

First and foremost among the new features is DoubleSpace,

which increases a disk's storage capacity by compressing the data on it. It's similar to third-party compression products such as Stacker, but it enjoys one significant advantage: It's an integral

part of the operating system and not an add-on.

The DoubleSpace driver is stored on system-formatted disks along with the system files IO.SYS and MSDOS.SYS. It's loaded early in the boot process, eliminating many of the synchronization problems that afflict users of third-party products. For example, most disk-compression products require you to add a statement to CONFIG.SYS that

IN THIS REVIEW

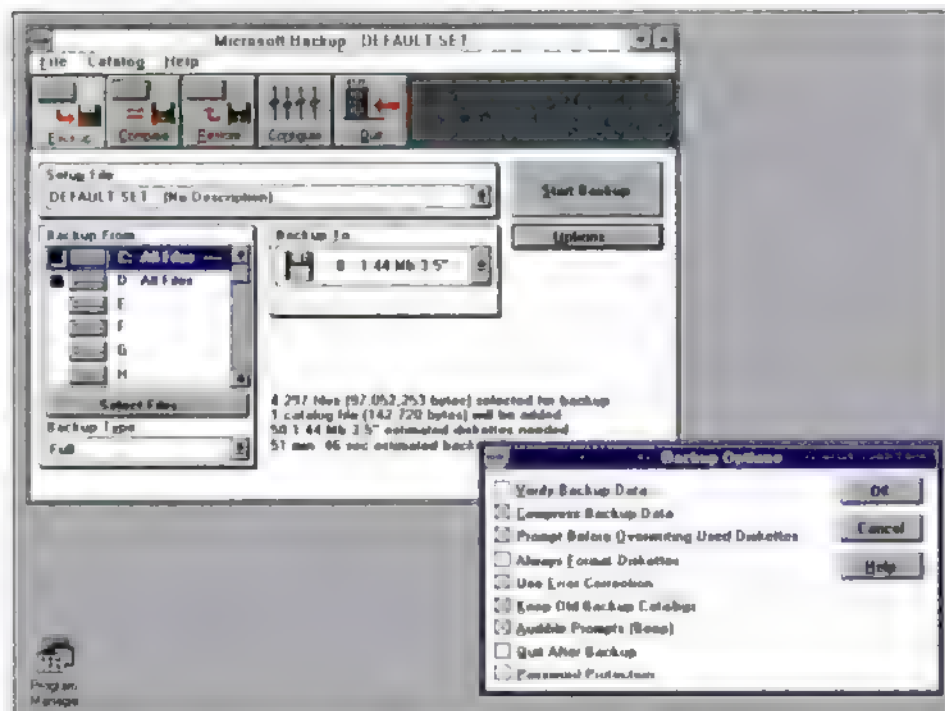
<i>Hard Disk Compression</i>	116
<i>Memory Management</i>	119
<i>Backup</i>	128
<i>Antivirus</i>	130
<i>Hard Disk Optimization</i>	140
<i>Multiple Start-up Utilities</i>	142
<i>Twelve Tips for DOS 6</i>	122
<i>Coming Attractions: Novell's DOS</i>	124
<i>DOS 7 Wish List</i>	139
<i>IBM Readies New DOS</i>	142
<i>The DOS 6 Annotated File Listing</i>	146

loads the compression driver. Until this driver is loaded, files stored on compressed drives are not visible, so the ordering of CONFIG.SYS commands is crucial. DoubleSpace eliminates this problem because compressed drives are "mounted" before CONFIG.SYS processing begins. You can even store CONFIG.SYS itself on a compressed drive or boot from a system-formatted floppy disk and still access compressed drives.

DoubleSpace typically delivers a compression ratio on the order of 1.8:1. It works on floppy disks as well as hard disks and offers you the choice of either compressing the existing files on a disk or leaving existing files alone and using only the free space on a disk for a compressed volume. DoubleSpace volumes are compatible with Windows and DOS utilities such as SmartDrive, CHKDSK, and Defrag, as well as third-party utilities, so you need not handle a compressed drive with kid gloves. DoubleSpace itself may be run from the command line or from an interactive, menu-driven control panel. For Stacker users, Microsoft makes a Stacker-to-DoubleSpace converter available. Significantly, compression and conversion are fully restartable processes, so you don't have to worry about losing everything on your hard disk in the event of an untimely power outage.

Are there any downsides to DoubleSpace? Only two. It increases the number of drive letters; compress the C: drive and you'll end up with two drive letters: one for the compressed drive and one for the uncompressed host drive. Also, the process of restoring a compressed drive back to uncompressed form is difficult.

Our Contributors: RICK AYRE is a technical director at PC Magazine Labs. CHRISTOPHER BARR is a senior editor (West Coast) of *PC Magazine*. BEN Z. GOTTESMAN is a project leader for the software team at PC Magazine Labs. BOB FLANDERS is president and senior systems analyst at NCI Systems in Annandale, Virginia. EDWARD MENDELSON, JEFF PROSISE, and BARRY SIMON are contributing editors of *PC Magazine*.



DOS 6 includes DOS and Windows versions of Microsoft's Backup, Anti-Virus, and Undelete. It can automatically add icons to Program Manager and commands to File Manager.

WHAT'S NEW IN MEMORY MANAGEMENT

The big news in memory management is MemMaker, which automatically configures 386 and 486 PCs to load TSRs and device drivers into upper memory. It analyzes your configuration and adds the commands to CONFIG.SYS and AUTOEXEC.BAT in order to create upper memory block (UMB) RAM and move residents of conventional memory up high. Even if you're a memory-management wizard who prefers to do things the

old way, you shouldn't cast MemMaker aside. It will detect some sources of conflict in upper memory that EMM386.EXE will not (such as late-activated adapter RAM buffers). And it considers all the permutations in determining where in upper memory to load TSRs and device drivers. Also, the Loadhigh and Devicehigh commands now accept switches telling them what region of upper memory to load a program or driver into.

EMM386.EXE has undergone major revisions. It now makes more UMB RAM available on most PCs, thanks to a more aggressive search routine. On IBM PS/2s, it maps UMBs over the space in the F000h segment containing ROM BASIC, increasing available UMB RAM even more. About half of EMM386.EXE now goes into upper memory (in DOS 5, all 9K of it went into conventional memory), and EMM386.EXE now acts as a Virtual Control Program Interface (VCPI) server at all times, allowing DOS-extended programs such as AutoCAD to run in a V86-mode environment even if EMM386.EXE was started with a NOEMS (no expanded or extended

HIGHLIGHTS

DOS 6

ON-THE-FLY COMPRESSION is built into the DOS kernel. Type DBLSPACE and DOS 6 almost doubles the capacity of your hard disk.

A MEMORY-MANAGEMENT program called MemMaker automatically frees up conventional memory and writes your AUTOEXEC.BAT and CONFIG.SYS files for you.

MICROSOFT ANTI-VIRUS and Backup are built-in menu-driven programs with enough functionality for standalone users. But they won't put third-party utilities out of business.

WINDOWS versions of Backup, Anti-Virus, and Undelete are included.

NEW START-UP options enable you to bypass lockups by hitting F5 to clean boot your system. You can also step through CONFIG.SYS line by line or choose from a selection of configurations.

TWO LAPTOP TREATS: One program connects two PCs so you can transfer files; another conserves battery life on Advanced Power Management-compliant laptops.

A LAWSUIT was filed in late January against Microsoft by Stac Electronics, which alleges Microsoft's DoubleSpace uses technology patented by Stac. The complaint asks for a jury trial and monetary damages.

memory) switch. But perhaps the greatest improvement to EMM386.EXE is its ability to allocate expanded and extended memory from a shared pool, so you no longer have to choose between them at start-up.

The output from the Mem command has been changed to improve readability. Mem also supports two new switches: /F, which lists free space, and /M, which lists memory blocks that belong to a specified program.

NEW START-UP OPTIONS

Users who routinely edit their AUTOEXEC.BAT and CONFIG.SYS files to boot custom configurations for certain programs will appreciate DOS 6's multiple configuration options, which let you define a start-up menu in CONFIG.SYS and then choose the desired configuration each time you boot up. Menus can be customized by varying the screen colors and specifying default menu options and time-out values. You can even organize complex menus into hierarchical menus and submenus.

Two new start-up options will come in handy when a statement in CONFIG.SYS or AUTOEXEC.BAT causes lockups. Pressing F5 when DOS's start-up screen is displayed initiates a clean boot, which bypasses CONFIG.SYS and AUTOEXEC.BAT. Pressing F8 starts an interactive boot, which processes CONFIG.SYS line by line and lets you execute or skip each statement.

The new Choice command lets you write batch files that act on user input. You specify the valid input keys and Choice returns an ERRORLEVEL code that reflects the key that was pressed. You may also spice up CONFIG.SYS commands with a question mark to the left of the equal sign, so DOS will ask you if you want to execute a command.

BRIDGING THE DOS/WINDOWS GAP

DOS 6 comes with three new utilities that ship in both DOS and Windows versions: Microsoft Backup (a subset of The Norton Backup), Microsoft Anti-Virus (a subset of Central Point Anti-Virus), and Microsoft Undelete. Microsoft Backup is



Join *PC Magazine* editors and Microsoft product executives in ZiffNet's Executives Online Forum for a discussion of DOS 6, from March 31 to April 4, 1993. You can follow the action by typing GO ZNT:EXEC at any CompuServe prompt.

an interactive, full-screen backup and restore program. It doesn't support tape drives or high-speed direct memory access (DMA) data transfers, but it does compress data to reduce the number of floppy disks required. Microsoft Anti-Virus provides active and passive protection against hundreds of known (and unknown) viruses, while Microsoft Undelete provides three levels of delete protection. DOS 5 has only two. The new option is *sentry undelete*, which copies deleted files to a hidden directory. These files can be undeleted without restriction, if they haven't been purged to make room for other files. The setup program adds commands invoking these programs to File Manager's menus.

DOS 6 also comes with an enhanced SmartDrive similar to the one introduced with Windows 3.1. SmartDrive now caches floppy disks as well as hard disks, performs write caching as well as read caching, and offers a double-buffering option so it can be safely loaded high on systems with non-VDS (Virtual DMA Services) hard disk controllers that perform bus mastering. And to keep your disk running smoothly, DOS 6 comes with Defrag, a scaled-down version of The Norton Utilities' Speed Disk.

Other new and improved commands

in DOS 6 include Move, which moves files and renames subdirectories; Del-tree, which removes subdirectories, even if they contain files and other subdirectories; Numlock, which toggles NumLock on or off from CONFIG.SYS; and Microsoft Diagnostics (MSD), a system information utility similar to diagnostic products such as Quarterdeck's Manifest. The DIR command has been enhanced with a /C switch to display compression ratios for files stored on DoubleSpace drives. The Help command brings up a help system documenting every DOS command, replacing the documentation.

DOS 6 contains a pair of treats for laptop users. First, there's Interlink, which lets you cable two PCs together by serial or parallel port and access disk and printer resources of one from the console of the other. Second, there's a driver named POWER.EXE that enacts Advanced Power Management (APM) on laptops that support it. Microsoft claims that the driver can extend battery life by 25 percent on APM-compliant laptops and by 5 percent on non-APM models.

Shortly before Microsoft was to ship DOS 6, it decided to drop the network component known as Workgroup Connection and sell it separately for \$39.95. Microsoft reports that the component confused users; some thought they couldn't connect to a network without it. Others thought it promised a full DOS-based peer-to-peer networking system. In fact, it provides only a client connection to Windows for Workgroups, Windows NT, and LAN Manager networks.

FACT FILE

MS-DOS 6.0 Upgrade Kit

Microsoft Corp., One Microsoft Way,
Redmond, WA 98052; 800-426-9400,
206-882-8080; fax, 206-936-7329

List price: Retail upgrade, \$129.95 (\$49.99 until May 31). Network license paks: 3-user, \$319.95; 20-user, \$2,080; 100-user, \$9,095.

Requires: 640K RAM, 5MB free hard disk space, (6.5MB for Windows users).

In short: DOS 6 can double your hard disk's capacity, automatically configure memory, protect against viruses, manage file backup, and more. Power users, however, will still turn to third-party utilities for advanced features.



ON READER SERVICE CARD

THE LAST STAND

DOS 6 packs in so many bells and whistles that you may be left wondering where Microsoft could possibly go with version 7. An obvious course would be to build in a DOS Protected Mode Interface (DPMI) super server similar to the one in Windows, enabling specially written applications to access more than 1MB of memory. Other options include adding a Virtual 86-mode multitasker and task switcher so that "old" DOS applications could run concurrently, and adding support for installable file systems. But the computing world would be better served by a true 32-bit protected-mode operating system built for the 1990s than it

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would be by more band-aids and fixes to a 1970s-era system designed to run in real mode. Unofficial indications are that DOS 7 may contain elements of the Win32 kernel—without, of course, the graphical user interface.

Is this DOS's last stand? Don't bet on it. DOS currently runs on many tens of millions of PCs around the world, quietly getting the job done day in and day out. Even if Microsoft stopped supporting it tomorrow, DOS would be around for years to come. DOS 6 is just one more reason to stick with an old friend—and wait to see what future releases may hold.

Hard Disk Compression

BY CHRISTOPHER BARR

Of all the new utilities included in DOS 6, DoubleSpace, the real-time disk compression utility that stores data in about half the previously needed space, has the most far-reaching implications. Those who were reluctant to use the compression in third-party products like Stacker and SuperStor PRO will appreciate the comfort factor of an operating system-resident disk compressor.

Actually, it's been safe for years. Stac Electronics' Stacker (800-522-7822) and AddStor's SuperStor PRO (800-732-3133) have been compressing disks safely for years now, and SuperStor PRO has been bundled with Novell's DR DOS 6.0 for more than a year.

So how different is Microsoft's disk compression from Stacker and SuperStor PRO? Not much, technically. And if you use Stacker or SuperStor PRO, you can continue to use them under DOS 6. But Microsoft has added a few compelling twists.

When you first type DBLSPACE at the DOS prompt, the software creates a hidden file, called a compressed volume file (CVF), on your hard disk. A device driver tricks the operating system into thinking that the file is a disk drive and gives it a new drive letter, D: for instance. The compression engine then intercepts the data headed for the CVF

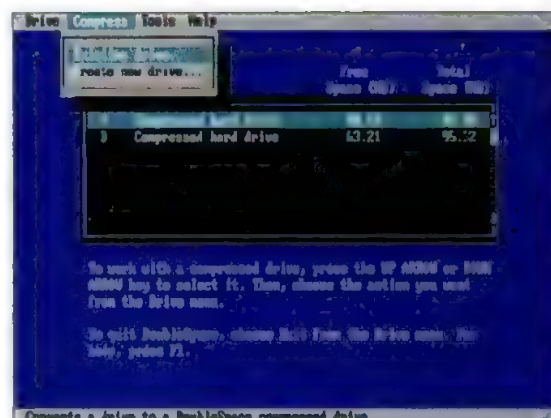
and compresses it before it's written to the disk, or uncompresses the data as it's read from the CVF.

Stacker and SuperStor PRO load their drivers through CONFIG.SYS and then swap the drives, renaming drive C: as drive D:, and vice versa. Dual copies of CONFIG.SYS and AUTOEXEC.BAT are kept on both drives.

Using technology licensed from Vertisoft Systems (and previously used in Vertisoft's DoubleDisk compression product), Microsoft has put disk compression into the DOS kernel. The DoubleSpace device driver is loaded when you boot up by IO.SYS instead of by CONFIG.SYS, giving DoubleSpace an advantage over the others because it swaps drives before CONFIG.SYS is processed.

Since the operating system knows where the compressed files are stored, it doesn't have to synchronize any changes made to your AUTOEXEC.BAT and CONFIG.SYS files as it does with Stacker or SuperStor PRO. You can type DIR/C within a compressed volume to display the file compression ratio.

As far as reliability goes, Microsoft appears to have made DoubleSpace



From this DoubleSpace menu, you can create, resize, format, and defragment compressed drives.

solid. Many of the traditional problems that plague compression users—such as when the loss of a line in your CONFIG.SYS file or of a driver from your hard disk means that you can no longer access the compressed drive—aren't there in DoubleSpace, because it is so tightly integrated into the DOS kernel. This also makes it easier for installation programs to find and modify CONFIG.SYS.

THREE ROADS TO COMPRESSION

DoubleSpace, Stacker, and SuperStor PRO are more alike than different. All three use a variation of the Lempel-Ziv compression algorithm. Microsoft calls

► FEATURES COMPARISON

Compression Utilities

Each of these utilities supports several media types: Bernoulli Boxes, floppy disks, RAM disks, RLL hard disks, and SCSI hard disks. Each also includes defragger, diagnostic, and management utilities. None currently supports Windows NT or OS/2 2.0, although the next version of Stacker will support OS/2 2.0.

Products listed in alphabetical order

	DOS 6	Stacker, Version 3.0	SuperStor PRO
■ = YES □ = NO			
List price	\$49.99 till 5/31, then \$129.95	\$149.00	\$149.95
Compression algorithm	MRCF	Stacker LZS	Lempel-Ziv
Converts to another compression format	■	□	□
Hardware compression available	□	■	□
Automated uninstall routine	□	■	■
Optimizer	□	■	■
Size of device driver	43K	41K	41K
User can load driver high	■	■	■
Mounts a floppy disk drive under Windows	□	□	■
Maximum number of compressed drives	23	10	8
Size of largest drive	512MB	2GB	512MB



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its version the Microsoft Real-time Compression Format (MRCF), while Stac calls its version Stacker LZS and AddStor economically calls its version Lempel-Ziv. The algorithm searches a file for repetitive data and replaces it with a token that represents the contents. The resulting file can then be stored in about half the space required by the uncompressed file.

The Lempel-Ziv algorithm works on the fly, meaning that it compresses a file when you write data to disk, and decompresses data when you read from the disk. Lempel-Ziv is a "lossless" algorithm, which means that no data is lost during the compression process.

All three programs create a hidden file on your hard disk where the compressed files are stored, and all three place the Microsoft Windows permanent swap file into an uncompressed volume. The speed at which the files are compressed and the approximate 2:1 compression ratio are comparable among the three programs. Since we worked with a prerelease copy of DOS 6, we haven't reported actual compression test results here. They will appear in an upcoming issue.

All three programs come with utilities that defragment and manage a compressed volume, but there are some real differences among the programs. And all except DOS 6 are able to optimize compression. DoubleSpace and SuperStor PRO can compress only 256MB of data at a time, giving you 512MB of uncompressed data. Stacker can compress a 1GB drive, providing 2GB of uncompressed data.

The greatest weakness of DoubleSpace is that it does not have an automated uninstall feature as do Stacker and SuperStor PRO. To uninstall it, you must back up the data that is stored on the compressed drive, delete the drive, and restore the data to an uncompressed drive. Microsoft also makes available a feature that allows users to convert a Stacker volume to a DoubleSpace volume—a time-consuming process that works at about 10 to 15MB per hour.

The Windows interface is lame in all three products. DOS 6 contains a File Manager dialog box that reports the size and compression ratio of a hard disk that

has been compressed by DoubleSpace. The dialog box will also give a file-by-file compression ratio. But none of the DoubleSpace utilities operate under Windows; you'll have to exit Windows if you wish to run them.

While all three programs let you compress a floppy disk, each takes a different approach. Floppy disks compressed with DOS 6 can be used only on a machine that uses DOS 6 and has DoubleSpace loaded in memory. It's not possible to read the compressed files on that disk with earlier versions of DOS.

Stacker comes with Stacker Anywhere, a program that lets you compress a floppy disk and use it (both read and write) on any PC, even if the PC does not use Stacker. SuperStor PRO has a Universal Data Exchange utility that lets you read from but not write to a floppy disk on any computer. SuperStor PRO is also the only program with a utility for both DOS and Windows so there's no need to drop to DOS to mount the drive.

In the hopes of establishing a compression standard, Microsoft is licensing the MRCI API for free. The Microsoft Real-time Compression Interface API will allow third-party vendors to create software and hardware that work with DoubleSpace. Some of the first utilities are expected from Symantec Corp. and Central Point Software. Eventually, hardware makers will put MRCI into hardware, and we expect to see DoubleSpace-compatible compression boards on the market pretty soon.

Both Stac and AddStor are announcing new products that will address the changing landscape of data compression. Shortly, Stac will offer an MRCI-compliant product for DOS 6 users that will supplant DoubleSpace. According to Stac, this new product will be safer and faster, and will create tighter compression than what Microsoft is offering in its DOS 6 package. Stac's new compressor will be bundled with a slew of utilities, and, like DoubleSpace, will have the advantage of hooking into the DOS 6 kernel.

AddStor is planning a new MRCI-compliant utility that

works directly with the DoubleSpace-compressed volumes to provide file management and give DOS 6 users the ability to share compressed files across a network, across communication links, and on floppy disks.

In January, Stac Electronics filed a lawsuit against Microsoft alleging that the DoubleSpace utility uses technology patented by Stac. While the complaint asks for both a jury trial and monetary damages, the lawsuit will not have any effect upon the initial release and shipment of DOS 6.

Memory Management

BY RICK AYRE

While DoubleSpace may be the novelty of DOS 6, MemMaker, a program that automatically optimizes memory on 386 and higher computers, is equally appreciated. DOS 5 made it possible to use memory more efficiently. Now, DOS 6 makes it easy, safe, and automatic.

You probably know that your PC has upper memory—between 640K and 1MB—much of which is unused. DOS 5 comes with a device driver called EMM386.EXE that converts unused space into usable RAM. Using the Devicehigh and Loadhigh commands in CONFIG.SYS or AUTOEXEC.BAT, you can load files, drivers, and programs into upper memory.

Getting the right statement and syntax

Memory Type	Before MemMaker	After MemMaker	Change
Free conventional memory:	588,112	630,816	42,784
Upper memory:			
Used by programs:	0	59,184	59,184
Reserved for Windows:	0	0	0
Reserved for EMS:	0	0	0
Free:	142,384	83,232	
Expanded memory:	Disabled	Disabled	

Your original CONFIG.SYS and AUTOEXEC.BAT files have been saved as CONFIG.UMB and AUTOEXEC.UMB. If MemMaker changed your Windows SYSTEM.INI file, the original file was saved as SYSTEM.UMB.

ENTER=Exit ESC=Undo changes

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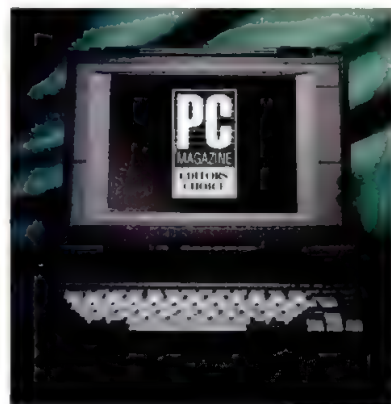
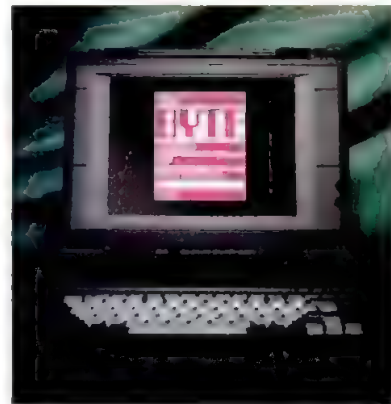
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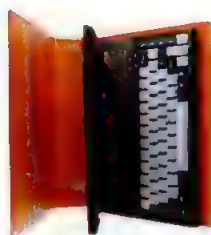
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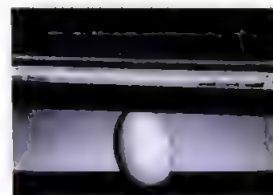
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at the right place at the right time is regarded by many normal people as PC voodoo. MemMaker automates optimization. Even before you start MemMaker, DOS 6 works your system's memory into shape. The improved EMM386.EXE conducts a search for free upper memory, and converts as much as 200K into usable RAM, as opposed to the 128K that DOS 5 recovers. And DOS 6 dynamically allocates expanded (EMS) and extended (XMS) memory from a shared pool, making it unnecessary to specify EMS memory needs at boot-up.

REAL MEMORY GAINS

To really see improvements in memory management, just type MEMMAKER at the DOS prompt. MemMaker seeks out unused upper memory, checks to see what you have loaded in CONFIG.SYS and AUTOEXEC.BAT, and then tries to load devices and programs into upper memory.

You can run MemMaker in batch mode, which requires no user intervention, Express mode, which requires little user intervention, or Custom mode, which offers advanced options. You can specify which drivers and programs to include in optimizations, determine how aggressively to scan upper memory, choose to use the monochrome region to run programs, and specify how to optimize upper memory for Windows. You can also choose whether or not to keep your EMM386's current exclude and include regions, and whether or not to move the Extended BIOS Data Area from conventional to upper memory.

MemMaker understands that upper memory is freed in blocks, so it uses block control to load programs into specific regions. It's also compression-aware, so it works with third-party compression products such as Stacker and SuperStor. It's also aware of programs such as SmartDrive that load themselves into upper memory automatically.

Finally, MemMaker is safe. It's designed so that no matter what kind of problem you encounter during optimization, the computer can recover without the need for specially-prepared boot-up disks. In fact, its recovery routines are among the cleanest we've encountered, and its undo feature is the best, bar none.

■ Twelve Tips to Get the Most Out of DOS 6

by Jeff Proise

Once you've got DOS 6 up and running on your PC, you may wonder what you can do to make the best use of it. Some of the answers are obvious: Expand your disk space with DoubleSpace, protect yourself from viruses with the new antivirus utilities, and so on. But other solutions are not so obvious. Here are twelve tips to help you use DOS 6 to the fullest.

Tip 1. Don't edit your start-up files to move TSRs and device drivers into upper memory; let MemMaker do it for you. In DOS 5, converting CONFIG.SYS and AUTOEXEC.BAT to load TSRs and device drivers high was a chore for all but the most sophisticated users. In DOS 6, MemMaker will make all the necessary changes for you, and it will optimize upper memory usage by determining where to load TSRs and device drivers in order to achieve the optimal fit. MemMaker will also detect most adapter RAM conflicts that EMM386.EXE will not. This can help to avert the lockups that a default installation of EMM386.EXE causes on some PCs.

If your PC contains a network card, run MemMaker *after* logging on to the network. This will ensure that the card's RAM buffer is activated and will be recognized by MemMaker.

Tip 2. Configure EMM386.EXE to provide an extra 24K of upper memory block (UMB) RAM. DOS 6's EMM386.EXE driver typically creates more upper memory than its counterpart in DOS 5 manages because it scans the E000h segment of upper memory for unused address space. (DOS 5's EMM386.EXE did not.) It does not, however, scan the region from C000h

to C5FFh on most PCs, leaving, potentially, 24K of UMB space unused. Use the Microsoft Diagnostics utility that comes with DOS 6 to see if this region is devoid of ROM and adapter RAM. If it is, add an I=C000-C5FF switch to EMM386.EXE in order to create 24K more UMB RAM.

You can create additional UMB RAM on some systems by starting EMM386.EXE with a Highscan switch. If this locks up your PC, perform a clean boot with the F5 key and remove the Highscan switch. If Highscan works on your PC, MemMaker will supply the additional UMB RAM for you.

Tip 3. Use the new Deltree command to remove subdirectories that aren't empty. Use the new Move command to move files. In the past, removing a subdirectory that wasn't empty meant deleting the files in it first. If the subdirectory contained other subdirectories, they had to be emptied and removed too. The new Deltree command removes a subdirectory no matter what else it contains—even other subdirectories. The new Move command provides you with a fast way to move files from one location to another. It will also rename subdirectories—a job that required a foray into the DOS Shell in Version 5.

Tip 4. Don't throw out DOS 5 just yet! Although the list of programs, drivers, and utilities that will ship with DOS 6 wasn't finalized at press time, it appeared that DOS 5's Mirror and Recover commands would be dropped. This would be unfortunate; running Mirror with a /PARTN switch is a handy way to back up the partition tables on your hard disk, and Recover—though a potentially dangerous com-

mand—can salvage files that have developed bad sectors. Before you throw out DOS 5, it's probably a good idea to make copies of MIRROR.COM and RECOVER.EXE. Make a copy of the DOS 5's Unformat utility as well, because you'll need its /PARTN switch to restore partition tables backed up with Mirror. Since DOS 6 contains its own Unformat command (without the /PARTN switch), give the old one a new name, such as UNMIRROR.COM.

Tip 5. Use COMMAND.COM's new /K switch to customize Windows. COMMAND.COM now supports a /K switch, which executes a program and then proceeds to the command prompt. This is a great way to customize the DOS prompt in Windows. In the program information file that loads COMMAND.COM, use a /K switch to specify the batch file that you would like executed when a DOS prompt window is opened.

You can also use /K to execute a batch file other than AUTOEXEC.BAT at start-up. The command

```
SHELL=C:\DOS\COMMAND.COM
C:\DOS /P K STARTUP.BAT
```

loads COMMAND.COM and processes STARTUP.BAT instead of AUTOEXEC.BAT. This is a great way to protect your start-up batch file from intrusive installation programs. It could, however, cause problems for installation programs that assume the file is named AUTOEXEC.BAT.

Tip 6. Conserve RAM by moving DoubleSpace to upper memory.

DOS 6's DoubleSpace driver DBLSPACE.BIN requires more than 40K of RAM. If you have sufficient UMB space available, you can move DBLSPACE.BIN to upper memory by adding the command

```
DEVICEHIGH=C:\DOS
DBLSPACE.SYS /MOVE
```

to your CONFIG.SYS file. Note that

without this command, DBLSPACE.BIN remains in conventional memory, robbing your application programs of much needed RAM.

Tip 7. Keep your hard disk running smoothly by running Defrag regularly.

Over time, the files on a hard disk become fragmented, which can severely impede file system performance. (*Fragmented* means files are no longer stored in contiguous clusters on a disk, which results in more movement of the drive heads when a file is read or written.) Run DOS 6's Defrag utility regularly—every two months or so—and your hard disk will continue to run as fast as it did the day you brought it home.

Tip 8. If Defrag runs out of memory, give it more with EMM386.EXE.

If your hard disk contains many fragmented files, Defrag may quit with an "out of memory" error. If this happens, and you're running Defrag on a 386- or 486-based PC with a color video adapter, try loading EMM386.EXE with the statement

```
DEVICE=C:\DOS\EMM386.EXE I=A000-B7FF
```

and run Defrag again. Configured this way, EMM386.EXE can increase the largest executable program size to more than 700K. If your 386 or 486 has a monochrome video adapter, use I=A000-AFFF instead of I=A000-B7FF. Do not start a program that runs in graphics mode when EMM386.EXE is configured this way. Note that this technique will not work if your PC contains an extended Basic Input/Output System (BIOS) data area.

Tip 9. Turn NumLock off with the new Numlock command.

Ever since IBM made NumLock ON the default when it introduced the PS/2s in 1987, utilities that toggle NumLock OFF at start-up have been in high demand. In DOS 6, you can turn NumLock off by inserting a NUMLOCK=OFF command in your CONFIG.SYS file. The NUMLOCK=ON command turns it on.

Tip 10. Use information in MEMMAKER.STS to fit more programs in upper memory. MemMaker determines what regions of upper memory in which to load TSRs and device drivers in order to achieve the best fit. But it never alters the order in which they are loaded. If UMB space is tight, you may be able to cram more into upper memory by varying the load order. The trick lies in determining the best load order.

Here's how to do it. After running MemMaker, look at the MEMMAKER.STS file in the DOS directory. For each TSR or device driver that it loads, MemMaker records the installed size (FinalSize) and the maximum size (MaxSize). For the best fit, load programs with the largest differences between FinalSize and MaxSize first. For example, if your mouse driver has an installed size of 17K and a maximum size of 58K, load it before a TSR with a MaxSize equal to or only slightly greater than its FinalSize.

Tip 11. Use POWER.EXE to conserve battery power on laptops.

If your laptop supports Microsoft's Advanced Power Management (APM) specification, loading DOS 6's POWER.EXE device driver can extend battery life by as much as 25 percent. Even if your laptop doesn't support APM, POWER.EXE can extend a charge by as much as 5 percent.

Tip 12. Store DOS in a subdirectory named DOS or MSDOS.

It has always been a good idea to store DOS in a DOS subdirectory, but now there is a compelling reason to do so. If your AUTOEXEC.BAT file doesn't set the Prompt and Path environment variables (or if you perform a clean boot with the F5 key), DOS will automatically set PROMPT equal to \$P\$G and PATH equal to C:\DOS or C:\MSDOS. However, it will set these variables only if DOS is stored in a subdirectory named either DOS or MSDOS. You should be aware that other subdirectories are not searched. □

► FEATURES COMPARISON

Memory Managers

Products listed in alphabetical order

■ = YES □ = NO	DOS 5	DOS 6	NetRoom	QEMM-386	386MAX
List price	\$99.95	\$49.99 till 5/31, then \$129.95	\$99.00	\$99.95	\$99.95
Automatically loads programs and drivers in UMBs	□	■	■	■	■
Allocates memory to EMS/XMS as needed	□	■	■	■	■
Reclaims UMBs	■	■	■	■	■
Allows clean boot	□	■	■	■	■
Instances DOS TSRs under Windows	□	□	■	■	■
Reports TSR initialization size	□	■	■	■ (not automatically)	■
Uses EMS page frame for initialization	□	□	■	■	■
Undo command	□	■	■	■	■
Acts as DPMI server	□	□	■	■	■

But DOS 6 does not blaze a new trail into the memory-management jungle. For years, other programs have been doing most of what MemMaker does. When it comes to automatic optimization, Helix Software's Netroom (800-451-0551), Qualitas's 386MAX (800-733-1377), and Quarterdeck Office Systems' QEMM-

386 (800-354-3222) play tricks that MemMaker isn't bold enough to attempt.

In designing MemMaker, Microsoft was safe rather than daring. You won't find the equivalent of 386MAX's ROM-Search, Netroom's NETSWAP, or QEMM's Stealth. And MemMaker does not offer any special techniques for opti-

mizing specific computers—as Qualitas's BlueMax does with PS/2s. With vendors hoping to outdo MemMaker altogether, you can expect to see some ambitious third-party upgrades. NetRoom 3.0, for instance, uses "cloaking" technology to stash its own customized PC BIOS and video BIOS in extended memory. (For

Coming Attractions: Novell's DOS

by Christopher Barr

When Digital Research was purchased by Novell in 1991, Microsoft's critics felt the MS-DOS stranglehold over operating systems would end. In their minds, what better home for DR DOS than Novell, a company that had tenaciously held its market share in network operating systems against Microsoft's Napoleonic advance? When no DOS was forthcoming, some derided Novell for squandering a treasure.

But DR DOS was only in suspended animation, and it's about to be revived with a new name and a slew of new features. As a part of Novell's Desktop Systems Group (DSG), along with NetWare Lite and NetWare for the Macintosh, DR DOS will be revised and shipped this fall with the name Novell DOS or NetWare DOS. It will be closely linked to NetWare and will include a number of technological im-

provements that should set high-water marks for innovation.

The most important new feature will be the universal NetWare client. This will let Novell's DOS connect to other versions of NetWare, including versions 2.x and 3.x and the upcoming Version 4.x. Novell's DOS will also provide peer-to-peer networking under DOS, operating in conjunction with a forthcoming version of NetWare called Personal NetWare.

The real gem in this new version's jewelry box of utilities may be the ability to multitask multiple DOS applications. While Quarterdeck Office Systems' DESQview has made that possible for a number of years, the feature had never been built into any version of DOS until now. The kicker is that Novell is releasing a new applications programming interface (API) called the DOS Protected Mode Ser-

vices (DPMS) API, which will let third-party developers write DOS applications that can be loaded and run in extended memory.

Though Novell's DOS will still include disk compression licensed from AddStor (makers of the SuperStor disk-compression product included in DR DOS, Version 6), its disk-caching software is newly purchased from Golden Bow Systems. Both utilities will be DPMS-aware, which means they can be loaded into extended memory, leaving a much larger amount of conventional memory free.

Novell's strategy is to provide all its customers with every operating system they may require. Given Novell's strong position in networking with NetWare, its recent purchase of Unix from AT&T, and the resurrection of DR DOS, the company seems to have all bets covered. □

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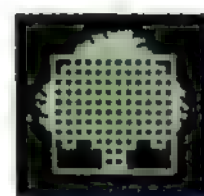
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Thinking Ahead.

more information, see this issue's Pipeline.) On many machines, though, MemMaker has more than enough technology to free up conventional memory.

Backup

BY EDWARD MENDELSON

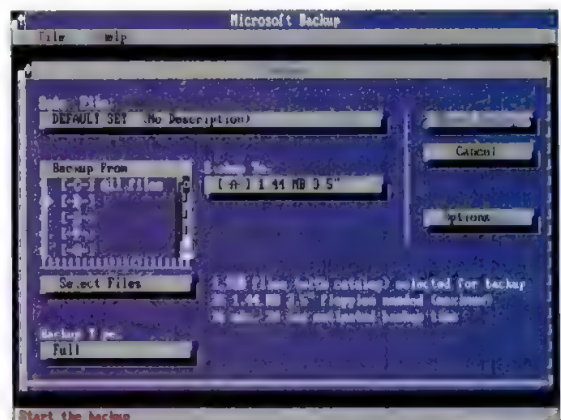
If you back up your files to floppy disks or to a network server, DOS 6 itself may be the only backup program that you will ever need. While it will eliminate any excuse for neglecting the regular backups that your data deserves, the power user may still want a third-party backup program that offers greater speed and flexibility.

Previous versions of DOS came with a command-line backup program whose arcane syntax, leaden performance, and restricted options seemed to be designed to discourage you from preserving your files.

The new DOS comes with two sleek menu-driven backup programs named

Backup for MS-DOS and Backup for Windows. Both make complex backup strategies straightforward and simple, and include error correction that lets you restore files from floppy disks that suffered damage after you used them for backups.

Both the DOS and Windows versions offer identical functions, and each can restore or verify backups made by the other. Both programs use file compression to reduce the time and number of disks needed for a backup. They let you select some or all files from one or more drives for your backups, and they let you restrict your selections by file dates. You can exclude all read-only, hidden, and system files, and you can tell the program to ignore any copy-protected files that you specify by name. Any selection of file specifications and other options can be saved in a default setup file, or in named setup files that you select from a menu



Finally, DOS has a backup program worthy of its name—menu-driven for full, incremental, and differential backups.

or from the command line.

DOS 6's backup programs allow three types of backups. The most familiar is a "full backup," which saves all the files that you select. (These files need not comprise a full disk; a "full" backup refers to the "full" set of files that you select for preservation.) Second is an "incremental backup," which saves only those files that have been changed since the

► FEATURES COMPARISON

Backup Utilities

Products listed in alphabetical order

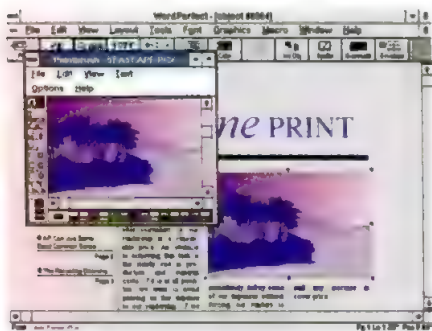
■ = YES □ = NO

	Central Point Backup	DOS 5	DOS 6	Fastback Plus	The Norton Backup
List price	\$129.00	\$99.95	\$49.99 till 5/31, then \$129.95	\$149.00	\$149.00
Types of Backups Performed					
Differential backups (files modified since last full backup)	■	□	■	■	■
Incremental backups can be added to disk with previous backup	■	■	□	■	■
Can back up files over or under specified size	□	□	□	■	□
Tape backups	■	□	□	■	■
Backs up NetWare file attributes	■ (version included in PC Tools only)	□	□	■	■
Restore Features					
Prompts user before overwriting newer file	■	■	■	■	■
Restores to different drive/directory	■ ■	■ □	■ ■	■ ■	■ ■
Restores files from DOS command line	■	■	□	□	■
Saves multiple user configurations	■	□	■	■	■
Additional Features					
Can resume interrupted backup	■	□	□	■	■
Windows version available	■ (\$129)	□	■ (included)	■ (\$149)	■ (\$149)
Estimates time and number of disks required	■	□	■	■	■
Offers password protection	■	□	■	■	■
Schedules automatic backups	■	□	□	■	■
Uses data compression	■	□	■	■	■
Uses macros	■ (version included in PC Tools only)	□	□	■	■

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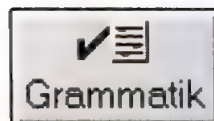


text and graphics, for example) and advanced capabilities (it's mail-enabled, allows easy creation of envelopes and bulleted lists, and supports DDE and OLE).

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WordPerfect

most recent backup, plus any added files that fit your original selection criteria for the full backup. Third is a "differential backup," which differs from an incremental backup by saving all files changed or added since the last full backup, even if they were previously backed up in incremental backups.

Once you've backed up your files, you can ask the program to compare files or restore them. Because a series of incremental and differential backups can include multiple versions of a file, you can select from a menu of different versions for comparing and restoring.

All of these features still may not satisfy you. Compared with the big three of third-party backup software—Central Point Software's Central Point Backup (800-445-4208), Fifth Generation Systems' Fastback Plus (800-766-7283), and Symantec Corp.'s The Norton Backup (800-441-7234)—Microsoft Backup, which is a subset of The Norton Backup, works relatively slowly and has no support for tape drives.

These third-party programs also use high-speed direct memory access (DMA) to the floppy disk controller, which allows them to back up files two to three times as fast as DOS 6, which lacks this high-speed floppy disk support.

If you have more than a few megabytes of hard disk to back up, you'll probably find floppy-disk backup intolerable. DOS 6's backup, like the third-party programs, lets you back up to a network server or any other device that you can identify with a drive letter. But DOS 6's program won't help if you want to back up to tape. Most tape drives come with their own software, but many users prefer the up-to-date interface provided by third-party utilities.

Unlike DOS 6, the third-party programs can back up Novell's network attributes, and come with schedulers that let you do unattended backups. You can protect DOS 6's backups with passwords that have to be entered before you can restore, but the protection is so weak that the password can be found on the floppy disks. In contrast, third-party programs let you encrypt your backups for even greater security.

If you don't have too many files to

preserve, DOS 6 will give you quite enough backup security. However, any of the major third-party packages will get the more demanding backup job done quickly and reliably. Since Microsoft Backup looks almost exactly like *PC Magazine's* most recent Editors' Choice backup package, The Norton Backup, the transition from DOS 6 to Norton may be easiest.

Antivirus

BY BEN Z. GOTTESMAN

The inclusion of Microsoft Anti-Virus (MSAV) with DOS 6 is a serious blow to the standalone antivirus software market. While not as full-featured as two of our past Editors' Choice programs, Central Point Anti-Virus, Version 1.4 (upon which MSAV is based), or The Norton AntiVirus, Version 2.1, MSAV provides a sufficient amount of protection for most users. Microsoft's package, however, lacks some of the features that are best appreciated by network administrators who are the ones responsible for main-

taining a virus-free workplace.

Microsoft has included both DOS and Windows versions of MSAV, which scans for and removes viruses from your system. In addition, there is a TSR, VSAFE.COM, which provides ongoing protection against the introduction of viruses into your system. The TSR uses between 7K and 44K of conventional memory, depending on the availability of extended and expanded memory.

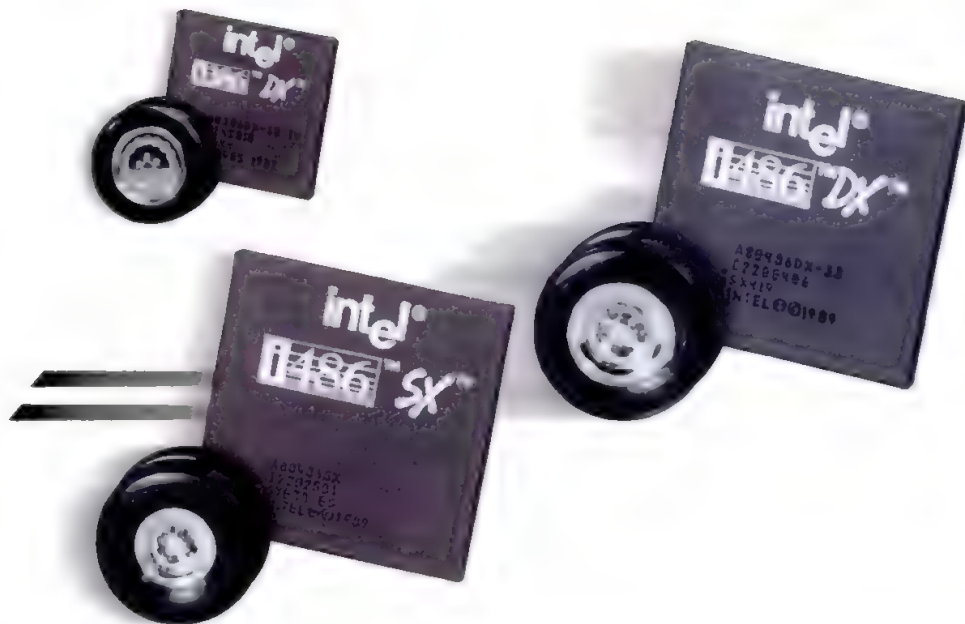
Both the DOS and Windows interfaces are clean and easy to use. If you are already familiar with Central Point Anti-Virus for DOS and Windows, you'll be immediately familiar with the MSAV interface. To check your system, simply select the drive you wish to scan and choose Detect (or Detect and Clean to remove viruses without pausing). The program will then look within each executable file for any of the 1,000 virus signatures in its database. And you can use integrity checking that will detect any change to a file, a common method of protection against unknown viruses. If the program encounters a virus, it will give you the option to remove it. The program should be able to accurately re-

► FEATURES COMPARISON

Antivirus Utilities

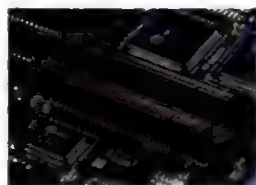
Products listed in alphabetical order			
	Central Point Anti-Virus for DOS and Windows	Microsoft Anti-Virus	The Norton AntiVirus, Version 2.1
List price: DOS and Windows versions	\$129.00 each	\$49.99 till 5/31, then \$129.95 for both	\$129.00 for both
Automatically scans at scheduled time	■	□	■ (Windows version only)
Creates emergency disk	■	□	■
Detection:			
Integrity checking	■	■	■
Signature scanning	■	■	■
Prevention:			
Creates boot sector image on hard disk	■	□	□
Available as a device driver	■	□	■
Available as a TSR	■	■	□
RAM requirements	3K-44K	7K-44K	2K-59K
Scans network drives	■	■	■
Alerts administrator to infections	■	□	■
Prevents log-on if device driver or TSR is not loaded	■	□	■
Customized alert messages	■	□	■
Prevents stop scan	■	□	■
Prevents user from modifying options	■	□	■

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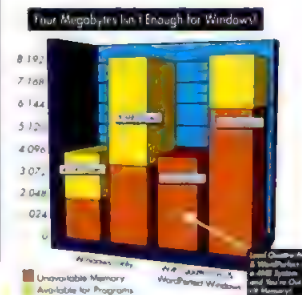
It combines a 256MB capacity, less than 13ms average seek time and an adaptive multi-segmented 64K cache. Add a data transfer rate of 6MB/Sec. and a mean time between failures of 250,000 hours and you'll have years of worry-free high performance. You can also choose Western Digital's AC2340 for \$150 extra. It has the same specifications, except for a 341MB capacity.



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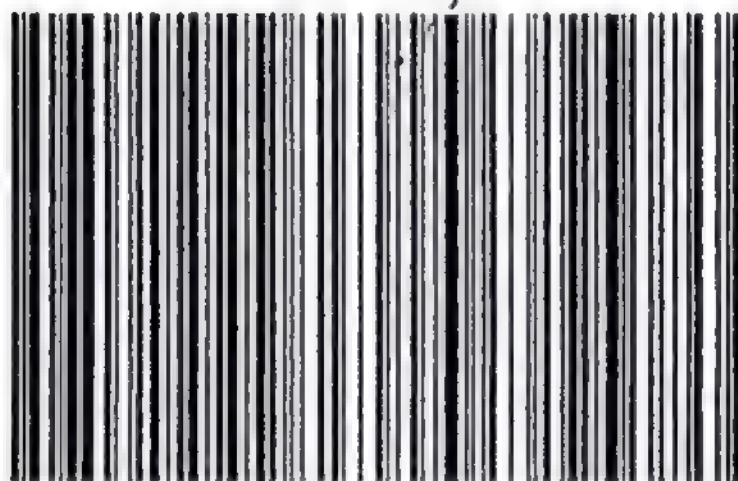
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1. Follow instructions on the other side

Back

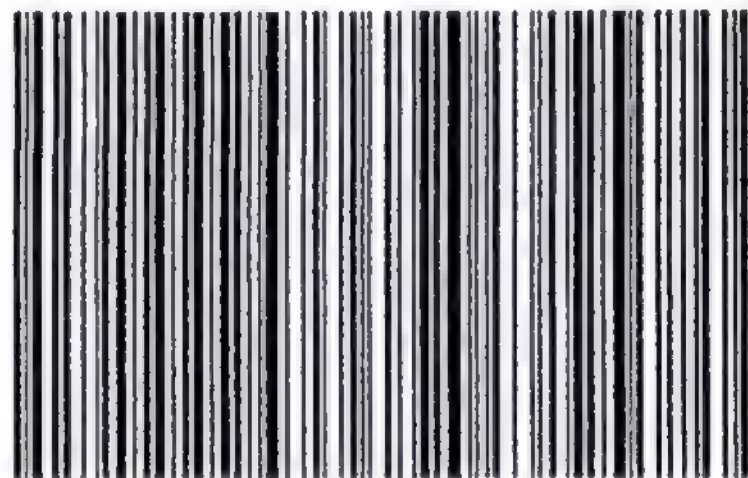
Gbs5lipBack-0018



Inverted Back

1. Follow instructions on the other side

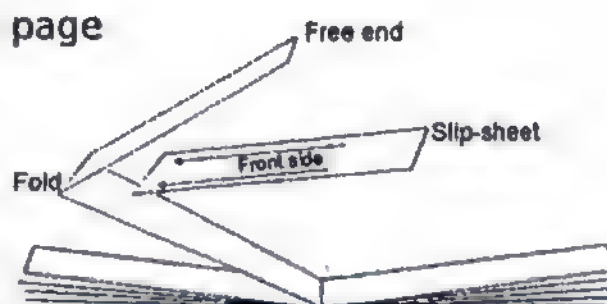
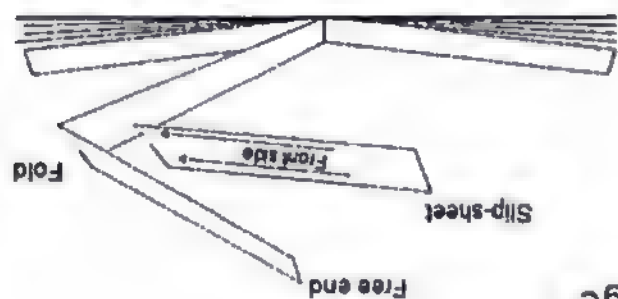
Folded edge of the page



Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



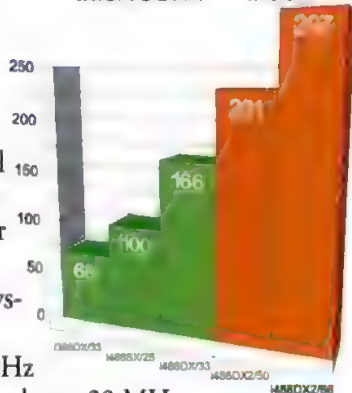
1. Open the foldout page
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 1. Front side touching the free page
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4. Close the page and slip-sheet

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Microprocessor Performance
Intel iCOMP™ Index



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How is a DX2 different from a standard DX? It utilizes Intel's speed doubler technology. The PC is divided into two parts: external

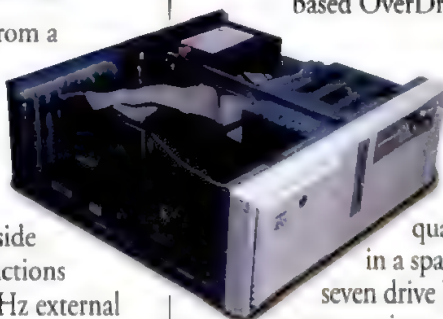
functions (outside the 486

microprocessor) and internal functions (inside the 486 microprocessor). The external functions operate at half the i486DX2's speed (33MHz external

for a 66MHz i486DX2). The internal functions operate twice as fast. An internal 'bus interface' controls the inter-

nal and external speed differences.

Is the system really much faster if the processor has to wait for the rest of the system? Absolutely, because the central part of the system runs twice as fast as it normally would. It's like if airplanes flew twice as fast. The in-flight portion would take half as long, but you & your bags would still get on and off the plane at the regular rate!



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The latest version of the top selling utility software! PC Tools 8.0 adds an all new DOS desktop with integrated application menu & manager, file viewer & manager, scheduler, and desk accessories. You also get Central Point's award-winning backup and a hot new version of Anti-Virus. PC Tools also includes DiskFix, FileFix, Undelete, Unformat, Disk Edit, Defragmenter, Cache and more! Central Point Commute lets you remotely run Windows or DOS applications and you get new RamBoost Memory Optimizer too!



Quattro Pro for Windows

"Quattro Pro for Windows is worth the wait" proclaims PC Magazine. QPW uses spreadsheet notebooks to easily organize your spreadsheets. Click your right mouse button and Object Inspectors lets you change attributes instantly! Speedbars give you those one-click shortcuts that change depending on what you're working on!



Interface Builder lets you build applications without programming. "QPW comes with a separate Database Desktop application - a beautifully designed query-by-example tool," says PC Magazine. "QPW's graphs are gorgeous and include rotatable 3-D types as well as options to adorn them." Need we add more?



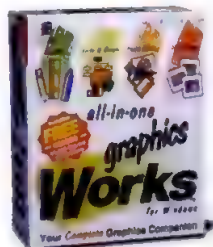
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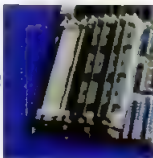
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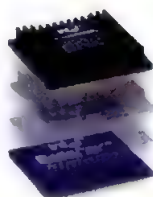
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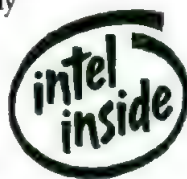
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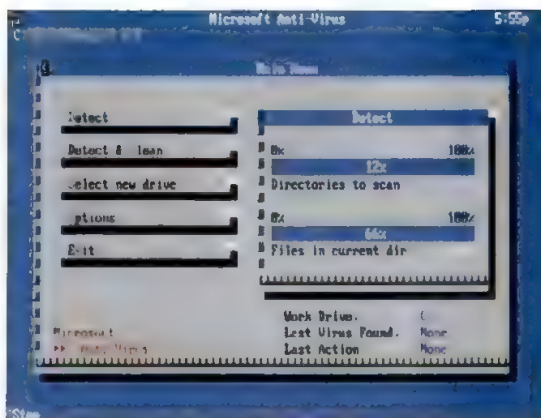
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move most known viruses while keeping the original portion of the file intact.

There is no way to scan individual directories from either the DOS or Windows programs, but there are several command-line options that make this possible. The Windows version of MSAV also supports limited drag-and-drop. You can drag and drop individual files from File Manager into MSAV, but not directories or multiple files. If you need a more selective scan from within Windows, you can always run MSAV for DOS from a Windows DOS prompt.

The VSAFE TSR will attempt to prevent infections by checking all files for viruses as they are opened, copied, or executed. If a virus is detected, an alarm will sound, and a window will pop up on your screen. Under DOS, you are given the option to stop, continue, or update the file's checksum. Under Windows, a dialog box will offer you options to stop and continue. The TSR is the same as the one found in Central Point Anti-Virus. The Norton AntiVirus uses a device



If you already know Central Point Anti-Virus you'll find the interface in Microsoft Anti-Virus familiar.

driver instead of a TSR. The advantage of this approach is that protection can begin before any other programs are executed.

THE FULL-FEATURED PROGRAMS

Programs like Central Point Anti-Virus and The Norton AntiVirus go beyond MSAV and provide options for controlling the virus-protection process. For example, you can customize the warning messages, prevent users from terminat-

ing scans before they are complete, or send an alarm to the network administrator when a virus is encountered. Both Central Point and Norton can even prevent the user from logging into the network if he does not have a memory-resident virus-detection utility loaded.

We were disappointed with the lack of virus detection during the installation of the DOS 6 upgrade. Nearly every antivirus program will first scan memory and the hard disk for viruses before proceeding with installation. This simple check is completely missing from DOS 6 (in order to save installation time, according to Microsoft).

Also, unlike most antivirus programs, MSAV includes no method of creating an emergency disk in case vital system data is lost. Emergency disks contain such data as copies of the boot sector, partition table, and CMOS and DOS system files.

Central Point will be handling upgrades to Microsoft Anti-Virus. The DOS 6 package includes two coupons for signature library upgrades for \$9.95 each.

■ DOS 7 Wish List

by Barry Simon

There was a time when DOS was easy to pick on. But now that we don't have EDLIN to kick around anymore and the backup program is finally worthy of the name, DOS's shortcomings are less glaring. Nevertheless, DOS users are still stuck with two big problems: the 1MB barrier and the slow, inefficient, and fragile file allocation table (FAT) file system.

But what about the less cosmic stuff that still affects users every day? At the top of the list are the command line and the DOS Shell. Neither one has changed in DOS 6. DOS 5 introduced DOSKEY, with its command history and aliases, but far better command-line enhancers are available, such as PCED (Cove Software, 410-992-9371, \$54.50) and 4DOS (JP Software, 800-368-8777, \$69). Unlike these programs, DOS has no command/file completion,

which, for example, would let you type "au," hit a file-completion key, and get the full name, "AUTOEXEC.BAT," filled in. And there's no way to put the time or date into an alias.

The DOS Shell could also stand some improvements. Its file organization is limited to two directories, and it does not offer a way to search for text within files. Also, it has only ASCII and hexadecimal file viewers. The DOS Shell's task switcher swaps only to disk and does not make the faster swaps to extended or expanded memory. And it has no way to start several sessions automatically.

Isn't it time for Microsoft to integrate CD-ROM support into the DOS kernel and load into the high memory area (HMA)? At last, the MSCDEX CD-ROM driver ships with DOS, so you don't have to hassle with getting a new version from your CD-ROM

vendor. But the changes to the driver are minimal, and SmartDrive still doesn't cache CD-ROM drives.

EDIT, also unchanged from DOS 5, is much better than EDLIN, but it's still not as good as the editors that ship as sample code with most compilers! At a minimum, EDIT should open several files at once, include an undelete feature, and offer better search capabilities.

Some of the features found in 4DOS's enhanced version of COMMAND.COM round out the wish list: a command-line text viewer better than Type, smart wildcards that understand "?1*.*" means files with an / in their names, an environment editor, paths more than 127 characters long, and an "except" command that allows you to perform actions such as copying all files except for the file you specify. □

The inclusion of antivirus software with the DOS 6 upgrade will undoubtedly raise user awareness of the need for protection against computer viruses. This will more than likely spur sales of more sophisticated programs, especially those that provide the features necessary for protecting an entire workplace. Whether you decide to stick with the software Microsoft has given you or upgrade to more feature-rich programs, you now have absolutely no excuse to leave your system unprotected.

Hard Disk Optimization

BY BOB FLANDERS

Microsoft provides two utilities with DOS 6 that extract the maximum performance from your disk drive: Defrag and SmartDrive. Defrag optimizes a disk's capacity by reorganizing the physical placement of the files and directories on the drive. SmartDrive speeds your computer's access to its DOS drives by retaining the most frequently accessed information from those drives in memory. Although Microsoft distributed SmartDrive with DOS 5, the company has added a new feature that provides even better performance.

DEFRAGGING ORGANIZES FILE SPACE

It is almost inevitable that with normal use files on a DOS drive will become fragmented. This occurs when the contents of a file are stored in noncontiguous areas of the drive. While this condition is not dangerous to your files, it requires more movement of the disk drive's read/write heads and slows down access to data.

DOS 6's Defrag reorders—or defragments—the files on a drive, ensuring that each file occupies a single, contiguous chunk of disk space. DOS can then access the defragmented files more quickly.

Defrag is a subset of the SpeedDisk utility found in The Norton Utilities from Symantec Corp. (800-825-2504), and its command line and user interface are very similar to SpeedDisk's. In fact, with the exception of a few command-line param-

eters, menu selections, and defragmentation strategies (such as file placement specification and the defragmentation of free disk space), Defrag fully measures up to SpeedDisk's reputation as a quality defragmentation utility.

Defrag also performs optimizations on drives compressed with DoubleSpace. Although it does not perform full defragmentation, Defrag is the only utility now available with this capability. The new SpeedDisk in Norton Utilities 7.0 also supports DoubleSpace.

Defrag supports two strategies: the simple unfragmenting of files, and total optimization. When unfragmenting files, Defrag performs the minimum amount of work needed to reorganize the files, usually leaving areas of free disk space scattered across the disk. With full optimization, Defrag rearranges all of the files and directories, compacting the used space into one area, and leaving a single, large free space on the hard disk. However, full optimization usually requires significantly more time to execute than just unfragmenting files.

Another option lets you sort directory entries on the hard disk in ascending or descending order by any combination of name, extension, size, or date and time. While DOS 5 can view directory entries in a sorted order (an option on the DIR command), this feature actually stores the directory entries in sorted order.



A subset of Norton's SpeedDisk, Defrag can defragment your hard disk, reordering scattered pieces of files to speed access to data.

Compared to Defrag's two strategies, both Norton's SpeedDisk and Compress (in Central Point Software's PC-Tools', 800-825-2504) offer five strategies that give you greater control over performance and speed. Another option lets you decide which files to leave in place. But you can achieve virtually the same effect with Defrag by marking a file as "hidden."

Unless you are a power user seeking absolute control over disk space organization, Defrag may be the only defragmentation utility you will ever need.

DISK CACHING SPEEDS YOUR READ

Regardless of how fast today's disk

drives are, they all can be considered slow when compared to the CPU. Relatively speaking, your computer sits there twiddling its thumbs while the disk drive takes interminable milliseconds retrieving a piece of data from the hard disk. However, SmartDrive can significantly speed access to information on a disk drive.

SmartDrive performs this magic by retaining the most frequently accessed portions of the disk in memory. When a program (or DOS) requests a read from the disk, and SmartDrive notes that the information is already in memory, it simply transfers the data from its buffer to the program's buffer.

Originally introduced with Windows, Microsoft also shipped SmartDrive with

DOS 5. The major improvement in DOS 6's version of SmartDrive is a new feature called delayed write, or write caching. Write caching captures the results of disk writes, and physically writes them to disk a second or two later.

By delaying the write, SmartDrive can often collect several write requests and execute them as a single write to the disk, saving the time that is normally consumed by head movement. Of course, should the system crash after a pro-



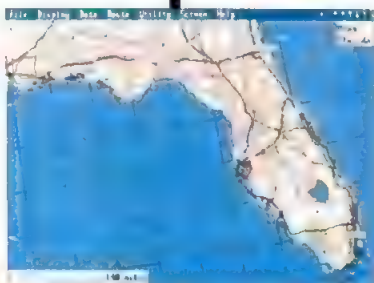
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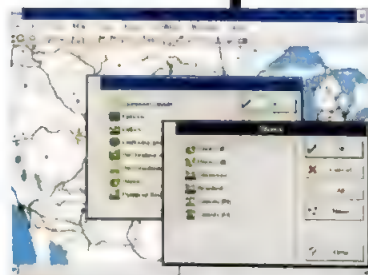


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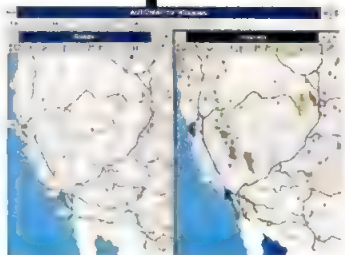
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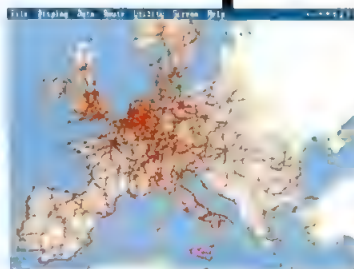
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gram has requested a write, but before the physical write occurs, the data is irretrievably lost.

A second enhancement to SmartDrive is called double buffering, a feature allows SmartDrive to interact properly with bus-mastering disk controllers.

In DOS 6, SmartDrive is no longer a device driver. Microsoft has reconfigured the utility as an executable file, allowing you to install SmartDrive from AUTOEXEC.BAT or from the DOS command line. In addition, after you have started SmartDrive, you can now request a display of its status, flush the cache, and start or stop caching on individual drives with a simple command.

Just as it has done with the other utilities included in the DOS 6 package, Microsoft has limited SmartDrive's flexibility, while preserving its performance. For example, in an unusual move, Microsoft removed the option that allowed you to place SmartDrive's cache into expanded memory. Since you can use only extended memory for the cache buffer, you cannot run SmartDrive unless your system has extended memory.

NCache, a utility supplied with The

Norton Utilities, and PC-Cache, a utility that comes packaged with PC Tools, both accept a wide range of cache sizes, such as 247K or 1,142K. SmartDrive, however, only accepts cache sizes in 1MB increments, such as 1,024K or 2,048K. NCache also allows you to write-protect cached drives. This prevents programs from writing to selected drives via DOS or BIOS, although NCache cannot prevent programs from writing to disk if they access the hardware directly. Neither SmartDrive nor PC-Cache supports this option.

Finally, you can uninstall NCache and PC-Cache by using a command-line argument, freeing up the memory that the utilities themselves are using. SmartDrive offers no such option, but you can disable and reenable caching for one or more drives from the command line.

While its performance and memory utilization are on equal ground with those of other third-party caching utilities, SmartDrive supports relatively few configuration options. While this may be perfectly acceptable to the average user, hard-core power users may want to consider other products with which to fine tune their systems.

Multiple Start-up Options

BY BARRY SIMON

Have you ever added a new driver to your CONFIG.SYS file and then discovered that it was incompatible with an existing driver? Your system probably choked and you probably searched around for a boot disk. If this sounds familiar, you'll love DOS 6's Clean Boot feature: Hit F5 before CONFIG.SYS processing begins and both CONFIG.SYS and AUTOEXEC.BAT are skipped. If you prefer, hit F8 and choose to either process or skip individual lines in CONFIG.SYS.

These are only a few of a host of new features in DOS 6 that give you flexibility in running your two basic configuration files. Among the new commands in CONFIG.SYS is one that turns NumLock on

■ IBM Readies New DOS

by Rick Ayre

It used to be that IBM, not Microsoft, sold DOS throughout the retail market. Sure, you got a copy of DOS with your computer, but if you wanted to upgrade, you bought IBM's DOS. And there were some great ones to buy. Remember classics like DOS 2.1 and DOS 3.3?

But when IBM stumbled with its release of DOS 4, a version many considered not quite ready for prime time, Microsoft sensed an opportunity. The success of Microsoft's DOS 5 upgrade kit is now legendary. So what has become of IBM's DOS?

IBM programmers are busy at work on their own DOS 6, targeted for release in the second quarter of this year. As of February, the feature set was not yet frozen, but you can expect IBM to compete in the same arena as Microsoft. Real-time disk-compression soft-

ware from a leading third-party developer will be integrated into the operating system kernel to help ensure safe operation, and IBM is enlisting leading third-party developers for an enhanced backup program and a memory-management program. Advanced antivirus software is being developed in-house.

Will it be a repackaged MS-DOS? Not likely. According to IBM, all of these enhancements will be based on core code different from the code base that was used to build Microsoft's DOS 6. Goals for improving the DOS kernel itself include a faster and smaller kernel (on the order of 1K), faster DOS screen I/O, faster printing through DOS, optimizations specific to 386 and 486 machines, and support for PCMCIA 2-compatible components such as credit card-size flash memory and modems.

That and more will likely sit atop the new features IBM already shipped with Version 5.02, including a file transfer utility, International Standards Organization (ISO) standard screen fonts, utilities for dealing with ejectable/lockable media such as CD-ROMs, and Advanced Power Management (APM) for laptops.

Later this year, IBM plans to introduce Workplace DOS, which places OS/2's Workplace Shell on top of DOS so that DOS, OS/2, and UNIX users will be able to work from a common drag-and-drop environment.

Can IBM compete with Microsoft? It has every intention of doing so. And as long as IBM continues to take DOS development seriously—and its DOS 6 efforts certainly suggest it is doing just that—you'd be mistaken in thinking of Microsoft as the only DOS player in town. □

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The DOS 6 Annotated File Listing

CONTINUES

Filenames alphabetized by extension.

Filename	Description
FILES INSTALLED ON ALL SYSTEMS	
DBLSPACE.BIN *	Compression kernel: handles all file compression and decompression
CHOICE.COM *	Accepts keyboard input in batch files.
COMMAND.COM	Displays the command prompt, interprets typed commands, and contains internal DOS commands
DISKCOMP.COM	Compares the contents of two floppy disks.
DISKCOPY.COM	Copies the entire contents of one floppy disk to another
DOSKEY.COM	Redisplays and edits previous commands and supports the creation of simple macros
DOSSHELL.COM	The DOS Shell and Task Swapper.
EDIT.COM	A full-screen menu-driven editor
FORMAT.COM	Formats a disk.
GRAPHICS.COM	Prints the contents of a screen
HELP.COM	Full-screen, menu-driven, on-line DOS command reference.
KEYB.COM	Configures a keyboard for a specific language.
LOADFIX.COM	Fills the first 64K of conventional memory so that no programs load there.
MODE.COM	Configures devices such as printers, monitors, keyboards, and communication ports.
MORE.COM	Enables the display of output one screen at a time
SYS.COM	Creates a startup disk by copying the DOS 6 system files (IO.SYS, MS-DOS.SYS, DBLSPACE.BIN) and COMMAND.COM to a disk
TREE.COM	Graphically displays the directory structure of a path or drive.
UNFORMAT.COM	Restores a disk erased by the format command.
EGA.CPI	Contains code-page information for EGA monitors
APPEND.EXE	Enables programs to open data files in specified directories as if they were in the current directory.
ATTRIB.EXE	Displays or changes file attributes.
CHKDSK.EXE	Finds and reports errors on a disk.
DBLSPACE.EXE *	Compression installation software and full-screen tool for maintaining compressed drives.
DEBUG.EXE	Displays information that helps programmers test and debug DOS programs.
DEFRAG.EXE *	Defragmenter: reorganizes files on a disk to optimize disk performance.
DELOLDOS.EXE	Deletes all OLD_DOS directories from a disk.
DELTREE.EXE *	Deletes directories and subdirectories
DOSHHELP.EXE	Lists and explains all DOS 6 commands.

* New in DOS 6.

Filename	Description
EMM386.EXE	Provides access to upper memory on 80386 and higher systems and simulates expanded memory in extended memory.
EXPAND.EXE	Expands compressed files from the setup disks.
FASTOPEN.EXE	Decreases the time needed to open frequently used files.
FC.EXE	Compares the contents of two files and displays the differences between them.
FDISK.EXE	Creates, deletes, and activates hard disk partitions
FIND.EXE	Searches for specific text in a file or files
INTERLNK.EXE *	Parallel or serial file-transfer client.
INTERSVR.EXE *	Parallel or serial file-transfer server.
LABEL.EXE	Creates, changes, or deletes a disk-volume label
MEM.EXE	Displays information about how memory is being used
MEMMAKER.EXE *	Memory optimizer for 80386 and higher systems.
MOVE.EXE *	Moves files or renames directories.
MSD.EXE *	Diagnostics tool that displays information about system hardware and software configuration.
NLSFUNC.EXE	Provides national language support for all devices at once
POWER.EXE *	Reduces power consumption on systems compliant with APM (Advanced Power Management)
PRINT.EXE	Prints unformatted text files
QBASIC.EXE	A programming environment for creating and executing BASIC-language programs
REPLACE.EXE	Replaces files in one directory with files that have the same name in another directory.
RESTORE..EXE	Restores backups made using the backup program from DOS versions previous to DOS 6
SETVER.EXE	Reports the DOS version number to programs designed for a different version.
SHARE.EXE	Provides support for sharing and locking files.
SMARTDRV.EXE *	Creates a disk cache in expanded or extended memory.
SMARTMON.EXE *	Monitors SmartDrive cache performance under Windows.
SORT.EXE	Sorts input and writes the results to the screen or a file.
SUBST.EXE	Associates a path with a drive letter
UNDELETE.EXE	Restores deleted files and tracks information about them.
UNINSTAL.EXE	Restores the previous version of DOS after the DOS 6 Upgrade is installed.



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The DOS 6 Annotated File Listing

ENDS

Filename	Description
WINA20.EXE	Enables DOS 6 to run with Microsoft Windows 3.0 in 386 Enhanced mode.
XCOPY.EXE	Copies files and directories.
PACKING.LST	Lists the files on each setup disk.
ANSI.SYS	Defines functions that change display graphics, control cursor movement, and reassign keys.
DBLSPACE.SYS	Relocates compression kernel (DBLSPACE.BIN) from conventional to upper memory.
DISPLAY.SYS	Supports different extended character sets (code pages).
DRIVER.SYS	Creates a logical drive that can be used to refer to a physical floppy disk drive.
HIMEM.SYS	Manages extended memory.
IO.SYS	The DOS Basic Input/Output System (BIOS) that prepares the system at start-up and contains resident device drivers.
KEYBOARD.SYS	A device driver that supports different keyboard layouts.
MSDOS.SYS	The DOS kernel: manages files, directories, memory, and environments
RAMDRIVE.SYS	Reserves a portion of RAM to simulate a very fast disk drive.
APPNOTES.TXT	Contains information about running specific programs with DOS 6
README.TXT	Contains information that is hardware-specific or was available too late to be printed in the manuals.

DOS TOOLS (NORMALLY INSTALLED BY DEFAULT)

VSAFE.COM *	Antivirus TSR: protects against unknown viruses.
MSAV.EXE *	Antivirus scanner and cleaner for DOS.
MSBACKUP.EXE *	New full-screen backup for DOS

WINDOWS TOOLS (NORMALLY INSTALLED BY DEFAULT)

VSAFE.COM *	Antivirus TSR: protects against unknown viruses.
MSTOOLS.DLL *	Windows 3.x File Manager extensions.x
MWAV.EXE *	Antivirus scanner and cleaner for Windows.
MWBACKUP.EXE *	Backup for Windows.
MWUNDEL.EXE *	Undelete for Windows
WNTTOOLS.GRP *	Windows Tools program group

UPDATE FILES (INSTALLED ONLY IF SETUP DETECTS AN OLDER VERSION OF THE FILE)

DMDRV.BIN	A device driver for the Disk Manager disk-partitioning program.
MOUSE.COM	Microsoft Mouse driver
MSCDEX.EXE *	Microsoft CD-ROM Extensions.

Filename	Description
SSTOR.SYS	A device driver for the SpeedStor disk-partitioning program

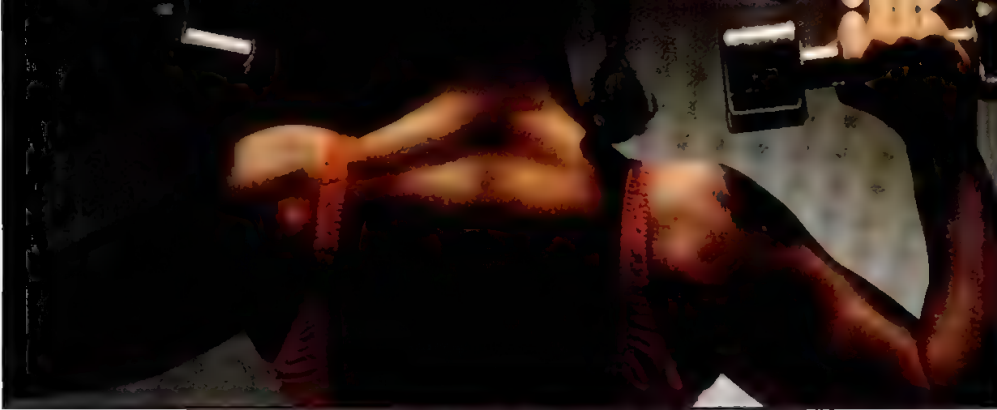
SETUP FILES (USED BY SETUP BUT NOT COPIED TO THE HARD DISK)

AUTOEXEC.BAT	Basic configuration.
SETUP.EXE	DOS 6 Upgrade installation program.
AV.GRP *	Renamed as WNTTOOLS.GRP during setup.
CONFIG.SYS	Basic configuration for setting up devices.

FILES REMOVED FROM DOS (DOS 5 VERSIONS AVAILABLE ON-DISK FROM MICROSOFT)

GORILLA.BAS	A sample QBASIC program.
MONEY.BAS	A sample QBASIC program.
NIBBLES.BAS	A sample QBASIC program.
REMLINE.BAS	A sample QBASIC program.
CV.COM	Update for older versions of the CodeView debugging program.
GRAFTABL.COM	Enables the display of extended characters of a specified code page in graphics mode.
MIRROR.COM	Tracks deleted file information; functionality has been folded into UNDELETE.EXE
MSHERC.COM	Provides support for a Hercules monitor running with Edit or QBASIC
PRINTFIX.COM	Disables verification of a printer's status line.
4201.CPI	Code-page information for IBM Proprinters II and III, Models 4201 and 4202.
4208.CPI	Code-page information for IBM Proprinter X24E Model 4207, XL24E Model 4208, and compatibles.
5202.CPI	Code-page information for IBM Quietwriter III Printer Model 5202 and compatibles
ASSIGN.CPI	Redirects requests for disk operations on one drive to a different drive.
LCD.CPI	Contains code-page information for certain liquid crystal displays
BACKUP.EXE	The old DOS backup program, replaced by MSBACKUP.EXE
COMP.EXE	Compares the contents of two files or two sets of files byte by byte.
EDLIN.EXE	A line-oriented text editor.
EXE2BIN.EXE	Converts executable files to binary format.
JOIN.EXE	Joins a disk drive with a directory on another disk drive
RECOVER.EXE	Recovers readable information from a defective disk.
PRINTER.SYS	Supports code-page switching for parallel-port printers

* New in DOS 6.



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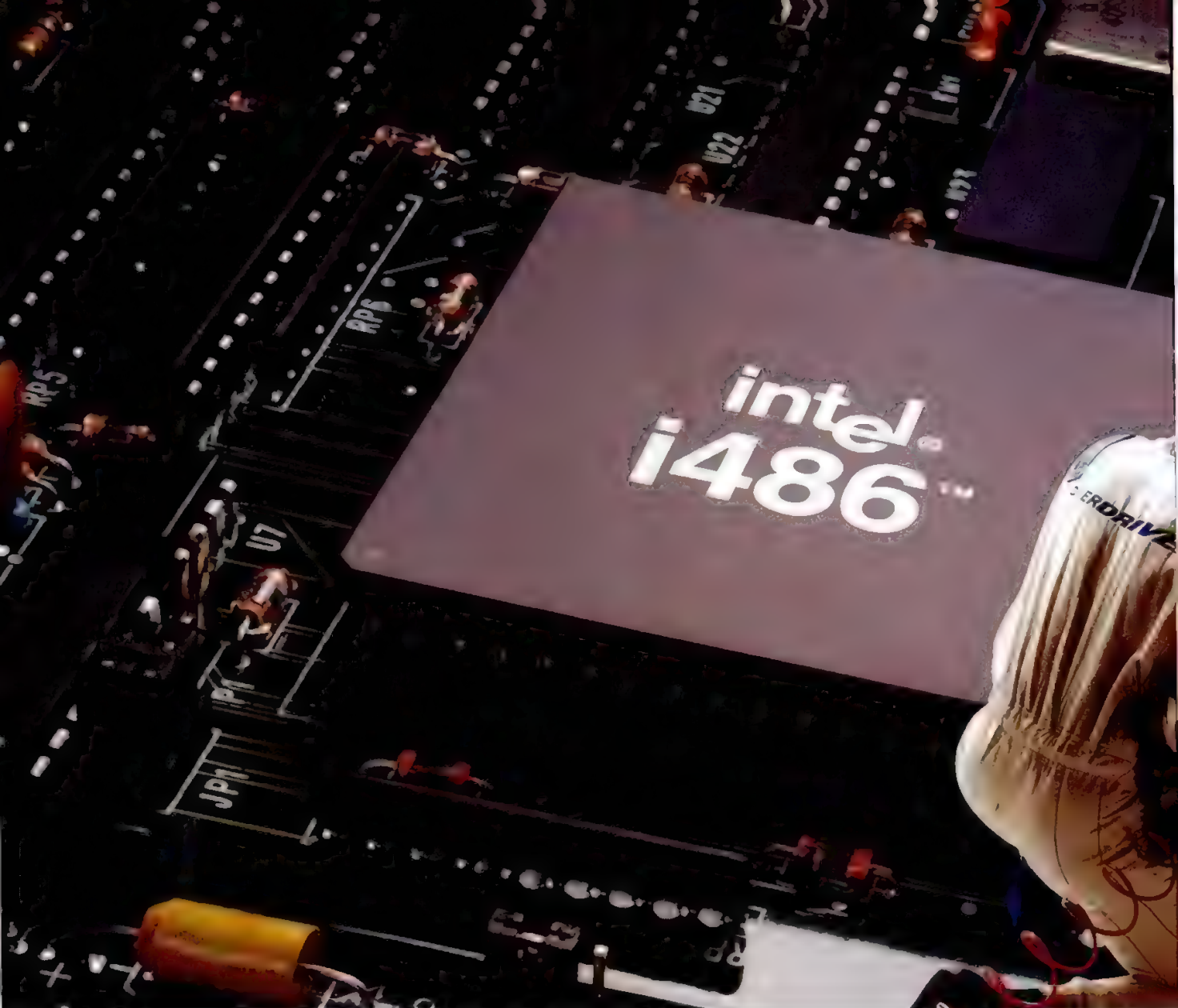
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*PC World, February 1993. Review of 486 Systems. **Notebooks not included.
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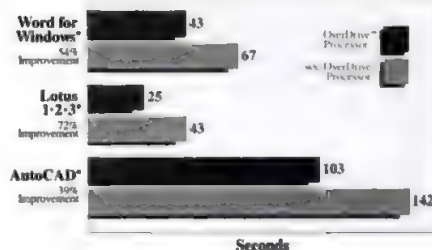
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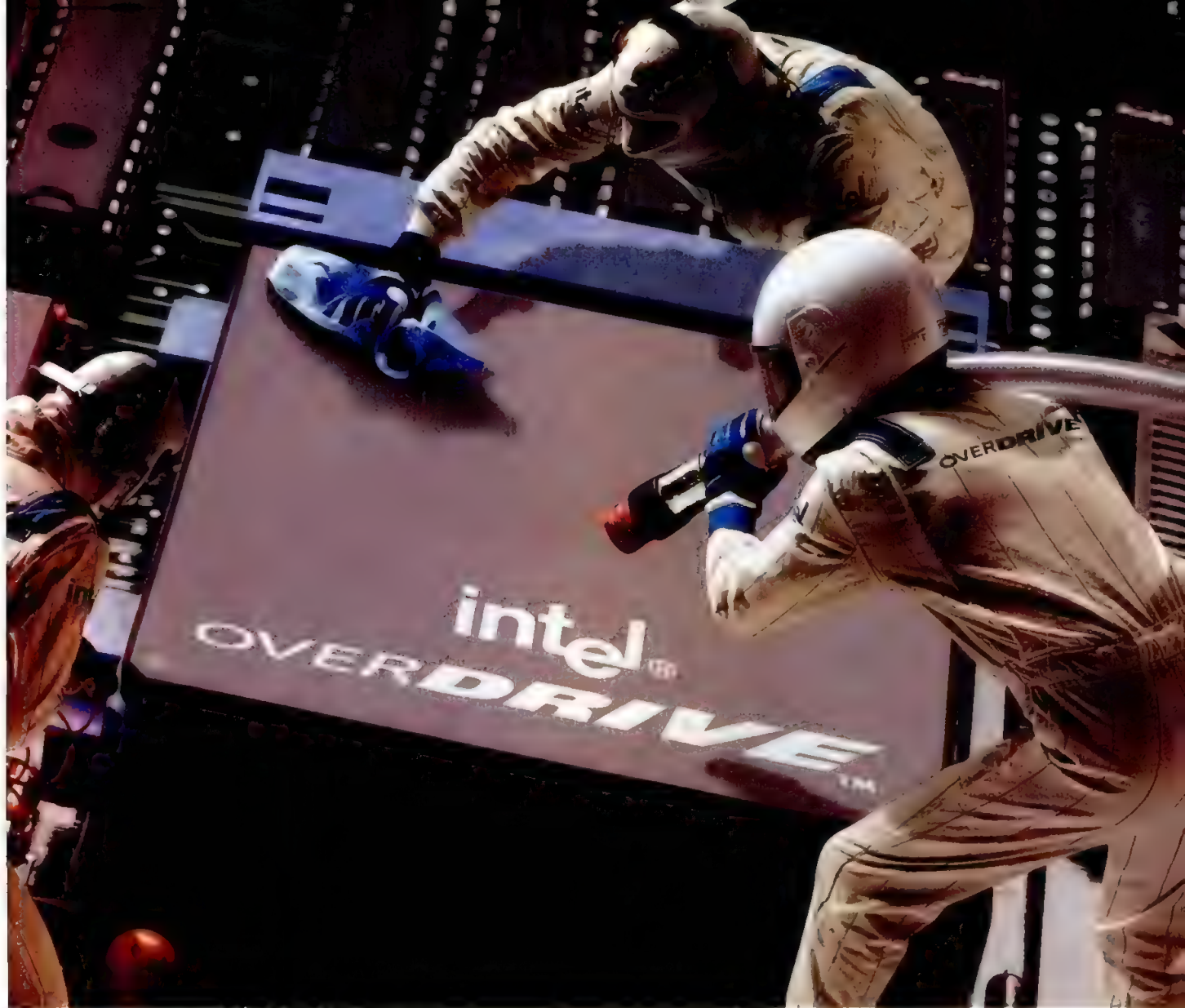
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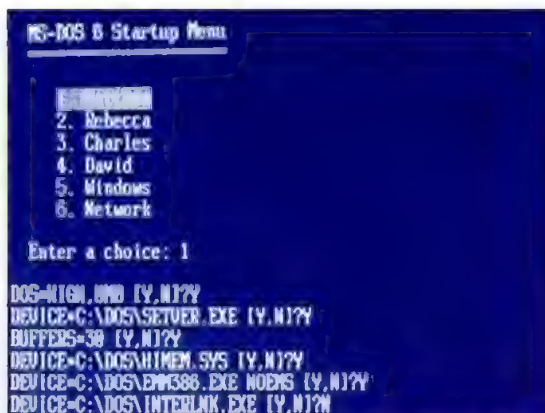
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and off and another that places variables in the DOS environment. There's also CHOICE, the first new batch command in many upgrades, which prompts the user to make a choice in a batch program. You might, for example, insert: CHOICE "Want to backup" so the string "Want to backup [Y,N]?" would appear on screen. If the user chooses to backup, Microsoft Backup would launch.

THE MULTIPLE CONFIGURATION MENU

If you're tired of managing multiple configuration files, one of DOS 6's more impressive features lets you store many configurations and then choose one from a menu during startup. This gives you the flexibility to load a Windows configuration only when you want, load certain drivers only when needed, and load custom configurations for different users.

Multiple configuration utilities have been available from third-party developers for a while. There's AutoCon (Larry Weaver, 916-623-5045), BootCon (Modular Software Systems, 800-438-3930), and BootSys (Hans Salvisberg, 713-524-6394). But the advantage of setting up multiple configurations within the operating system is a new clean syntax. Third-party products have to fool DOS and use DEVICE= and REM lines which make



This start-up menu provides access to several custom "configuration blocks" and corresponding AUTOEXEC.BAT commands.

reading the resulting CONFIG.SYS files difficult. DOS 6's syntax uses simple commands like "menu" and "item."

To use the multiple configuration feature, you place groups of statements called "configuration blocks" into your CONFIG.SYS file, preceded by a name you enter between brackets called the "block header." The first block uses the "Menu" header and can contain commands to alter a menu's colors, to change the default menu, and most important, to change the menu item and submenu commands. For each menu item, you can specify the text that will appear on both

the menu and the header of the block that runs when that item is chosen. Although there are nine items on the main menu, submenus can take up to 64K, ample space for a number of different configurations.

The block header that you choose is stored in an environment-variable "config" so you can match AUTOEXEC.BAT blocks to CONFIG.SYS blocks by adding a Goto command in AUTOEXEC.BAT.

We did find problems in using the multiple configuration option alongside the new mem-

ory optimizer, MemMaker. For example, MemMaker will change to Device commands all the Devicehigh commands that lie outside of the block you run with it. The only way to get MemMaker to run with the multiple configuration option is to use MemMaker on separate pairs of CONFIG.SYS/AUTOEXEC.BAT files and then to paste them into a combined configuration. This method for using MemMaker with multiple configurations is so complicated and awkward that it's hard to imagine anyone actually using it.

The third-party alternatives offer some features not provided by DOS 6,

and all three manufacturers plan upgrades soon. Of the upgrades, only BootSys was available for us to look at. BootSys and BootCon have slicker menus with borders, accelerator keys, or both. BootSys is a tinkerer's delight with limited branching, if/then statements, sequential submenus, and the ability to run a defragger and then reboot into a normal configuration.

AutoCon's configuration editor lets you view and edit single configurations at a time. (DOS 6 places all configurations in one file.) BootCon has announced a similar feature for its next version and currently includes a syntax checker and multiple boot scenarios similar to BootSys. □

► FEATURES COMPARISON

Multiple-Startup Utilities

Products listed in alphabetical order

	AutoCon	BootCon	BootSys	DOS 6
■ = YES □ = NO				
List price	\$15.00	\$79.00	\$39.00	\$49.99 till 5/31, then \$129.95
Can skip CONFIG.SYS/AUTOEXEC.BAT processing	■	■	■	■
Can skip single lines in CONFIG.SYS	■	□	■	■
Number of main menu items	8	26	20	9
Number of submenu items	1	1	24	Unlimited (up to 64K)
Offers accelerator keys in menu	□	□	■	□
Offers configuration editor	■	□	□	□
Offers passwords	□	■	□	□
User can customize colors in menus	■	□	■	■
User can single-step through CONFIG.SYS	□	□	□	■
User can set NumLock key from CONFIG.SYS	□	□	■	■
Uses default choice after timeout	■	■	■	■
User can set environment variables	□	□	■	■
Variables and branching available in CONFIG.SYS	□	□	■	□

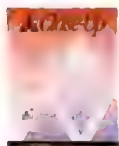
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Mouse	Y	Y	Y	Y	Y
Application SW	Y	N	Y	Y	N
Price	\$2,495	\$3,569	\$2,995	\$2,775	\$3,119

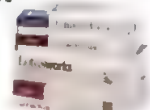
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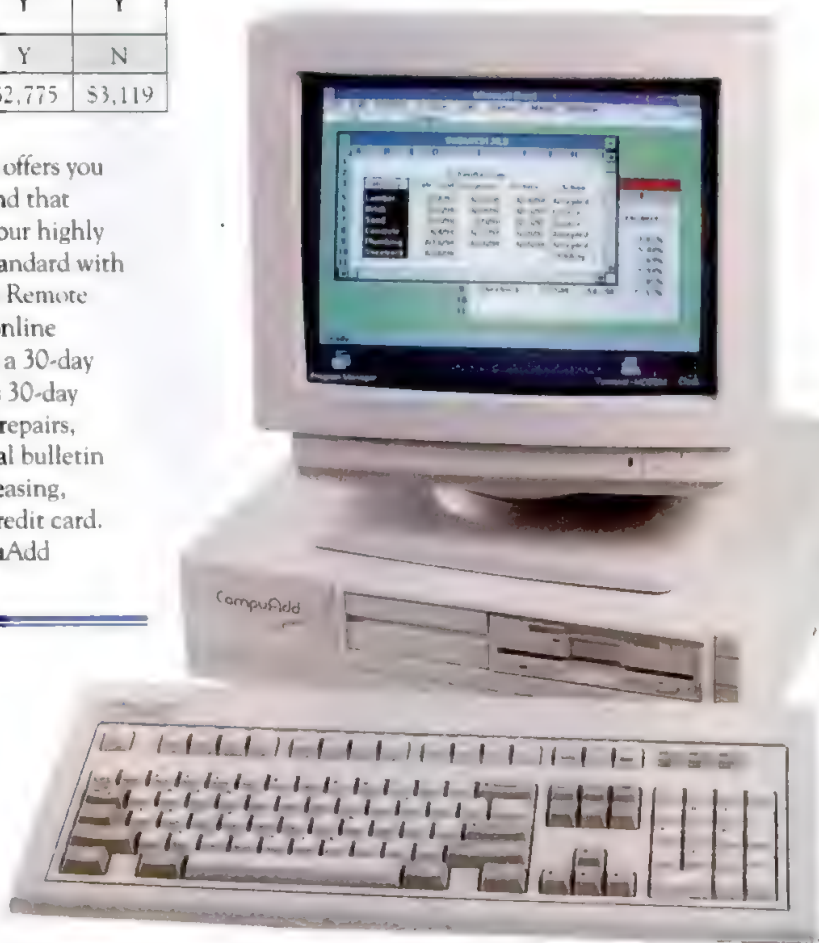


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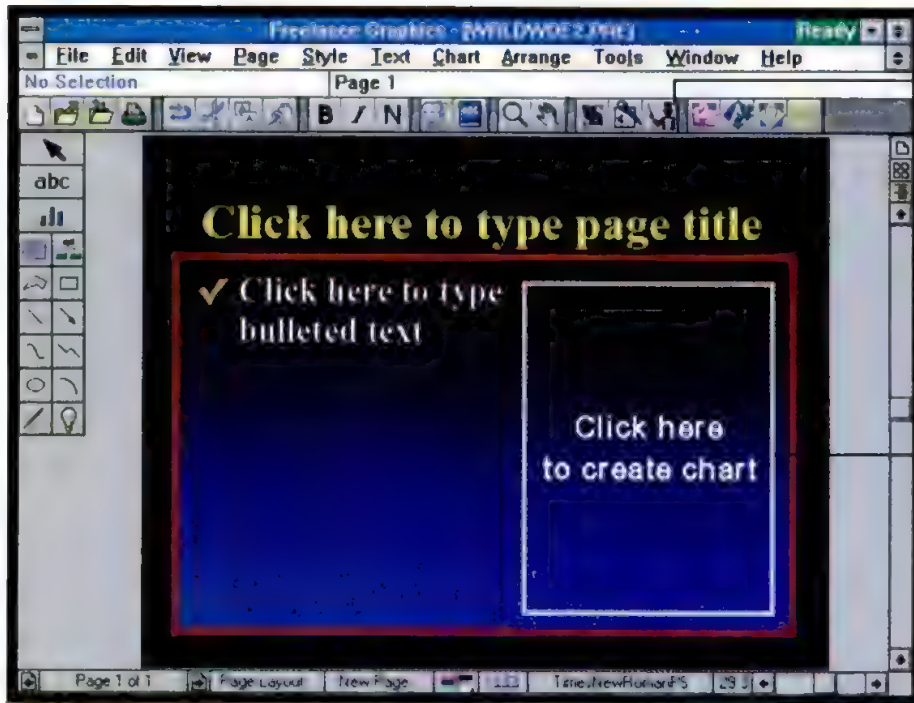
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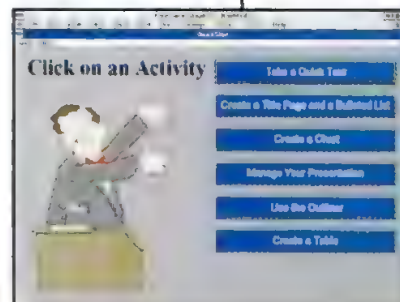
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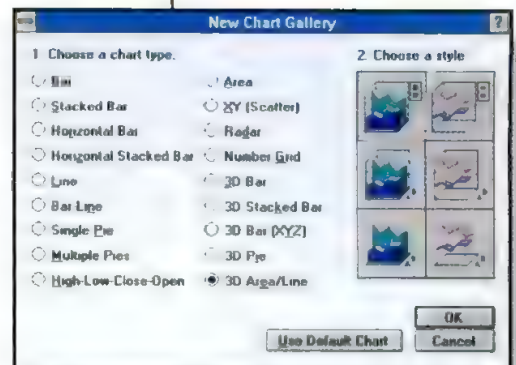
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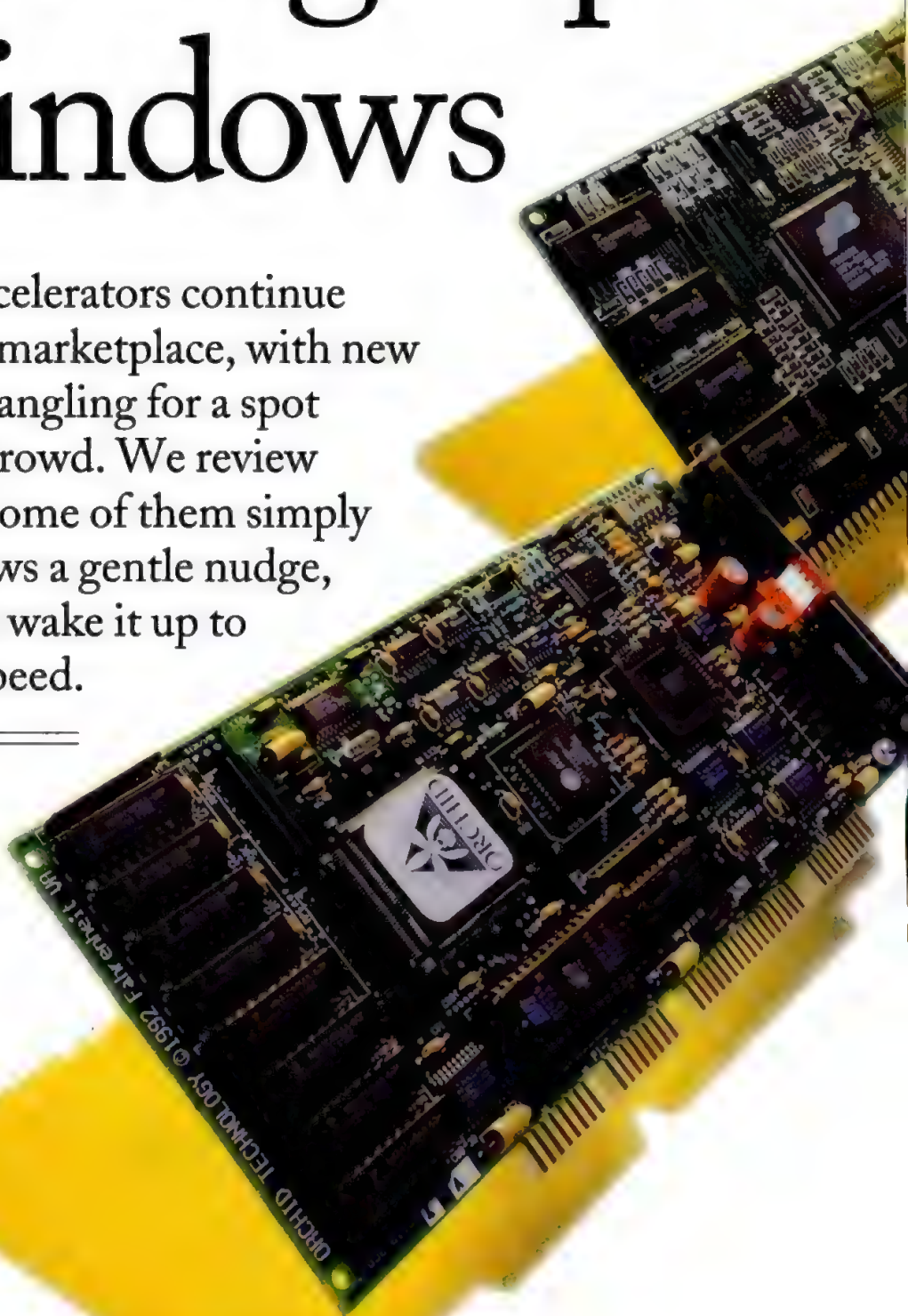
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GRAPHICS ACCELERATORS

Waking Up Windows

Graphics accelerators continue to flood the marketplace, with new chip entries angling for a spot among the crowd. We review 32 boards: Some of them simply give Windows a gentle nudge, while others wake it up to full-alarm speed.





Few things choke the performance of a PC faster than a sluggish video card. Fortunately, graphics accelerators and coprocessed video cards provide a simple and often inexpensive way to boost performance.

Vendors introduce new accelerator designs on nearly a daily basis, and the fierce competition has bred an assemblage of speed-up solutions list-priced as low as \$99. Often, just a few more dollars than that will buy you a pixel powerhouse that delivers Windows performance that may be up to three times as fast as frame-buffer VGA controllers. Compared with the accelerators we reviewed just three months ago, a greater number of the boards in this under-\$1,000 group offer more colors, better Windows performance, and lower prices. And prices have dropped 15 percent or more in comparison with many vendors' older accelerator offerings.

REVIEW CRITERIA

For inclusion in this review, *PC Magazine* requested EISA and ISA graphics adapters that accelerate Microsoft Windows functions in hardware, come with Windows 3.1 drivers for 800-by-600 or 1,024-by-768 resolutions, list for under \$1,000 with at least 1MB of memory, and were shipping in time for our testing period. Meeting these criteria were 4 EISA boards, 27 ISA, and 1 that does double duty as both. These graphics adapters range in price from \$99 to \$995 and most can display noninterlaced resolutions of at least 1,280-by-1,024. For PC users considering an entire system upgrade, PC Labs also tested five graphics accelerators designed for the Video Electronics Standards Association (VESA) VL-Bus, a local-bus extension of today's PC architectures (for more information, see the sidebar "The Shape of Boards to Come").

The largest contingent of adapters here (21) are based on S3 Corp.'s family of fixed-

by John R. Quain

HARDWARE

Graphics Adapters

► IN THIS REVIEW

Actix GraphicsEngine 32 Plus	166	ELSA Winner 1000.....	185
Actix GraphicsEngine Ultra.....	185	Focus 2 the Max TrueSpeed.....	166
Advanced Integration Research		Genoa WindowsVGA 24.....	206
Aview 2.....	204	Genoa WindowsVGA 24+.....	166
Advanced Integration Research		Hercules Graphite Card.....	199
Aview 2E.....	204	Hercules Superstation XP610.....	218
Alpha ASL Lightning SVGA.....	218	Linwen/Gaintec GXA.....	204
Artist Graphics WinSprint 900 Lite.....	185	Methus Premier 801.....	166
ATI Graphics Ultra Pro, EISA		Methus Premier 928-4M.....	185
Version.....	200	MicroStep AGC-2075e.....	218
Boca SuperX AcceleratorVGA.....	206	Mirage Storm 1280/256.....	166
Cardinal VideoSpectrumXL.....	206	National Design Volante AT800.....	218
Colorgraphic Twin Turbo		Nth S3 Advantage.....	166
Accelerator.....	204	Number Nine #9GXE.....	185
Compaq QVision 1024/E.....	200	Orchid Fahrenheit VA.....	166
Diamond Stealth Pro	185	PCG Photon 70/70 Deluxe	204
Diamond Stealth 24.....	166	SixGraph Wizard 924.....	204
Edge D24 BitBlaster Plus.....	206	Video Seven WIN.PRO.....	166

function accelerator chips, the S3 86C801, S3 86C924, and S3 86C928 (Hornet Technologies sent its EISA-based Hornet EVGA3, which uses the S3 86C805 chip, but we could not get it to work in our EISA test-bed). The next-largest GUI accelerator group (4) is founded on a new accelerator chip, the Cirrus Logic GD5426. Two companies continue to use their own fixed-function accelerators: ATI Technologies (the Mach 32) and Compaq Computer Corp. Also distinct in the accelerator category are Alpha Systems Labs' \$199 ASL Lightning SVGA, based on the Weitek W5286 chip, and the \$399 Hercules Graphite Card, based on the just-introduced IIT AGX-014 accelerator from Integrated Information Technology.

There are plenty more accelerator chips waiting in the wings. Soon you'll see Matrox Electronic Systems' new MGA (Multimedia Graphics Architecture) chip. (For more information, see the sidebar "New Accelerator Chip from Matrox on the Horizon.") Also coming are the Avance ALG2201, the Trident Microsystems Storm DG and Storm VG chips, the Tseng ET4000/W32, and the Weitek Power9000 for Windows accelerator, to name just a few. Look for EISA and ISA boards based on the chip sets reviewed here as well as on these upcoming designs; by the time you read this, entries will be available from companies such as Lava Computer Manufacturing, Opta, Portocom Technologies, Prism Imaging

Systems, Sigma Designs, Tangram Technology, VidTech Microsystems, and Zeny Computer Systems. Also, ATI should be out with its Mach 32-based \$249 VGAWonder Turbo. (We were unable to get another board that met our filter, the \$750 Number Nine #9GXi, in time for our testing.)

One continuing trend is the decline of coprocessed boards. Three of the reviewed adapters are based on Texas Instruments' programmable TI TMS34020 coprocessor (a fourth TMS-34020-based board, the MicroStep AGC-2075+, was submitted for this review, but we were unable to get it to work). Unlike fixed-function graphics accelerators, which have common graphics calculations built into the chip, coprocessors are fully programmable. This makes the TMS34020 adapters inherently more flexible than the other cards reviewed here. But the number of dedicated Windows and AutoCAD graphics functions built into fixed-

function accelerators has continued to grow, with chips such as the 86C801 and 86C928 adding point-to-point line drawing for use in CAD operations and stretch BitBlts for scaling digital video under Windows. This puts further price/performance pressure on coprocessed boards.

For example, the once-predominant 16-bit TMS34010 coprocessor can no longer compete against less-expensive S3 accelerators: At least one vendor declined to submit its under-\$1,000 TMS34010-based board because it didn't think a product based on this older technology could perform well against the new silicon. Even GUI accelerator chips are falling by the wayside, or threatening to. S3's 86C911 chip has been discontinued; its replacement is the 86C924, a software- and hardware-compatible upgrade to the 86C911 that now supports 24-bit color. But as you'll see, the 86C924 has a hard time standing its ground against the competition—including its siblings.

BENCHMARK TEST RESULTS

We subjected all 32 adapters to PC Magazine Labs' suite of tests to determine their performance with DOS VGA, Windows 3.1, and AutoCAD 11. We supplemented the benchmark tests with a barrage of Windows applications tests, including CorelDRAW 3.0, Excel 4.0, and Word for Windows 2.0a.

This review also marks a change in PC Labs' test-bed. Looking forward to the rise of the VL-Bus standard, we evaluated all the boards on 33-MHz 486DX PCs rather than 25-MHz 386DX systems. Since test scores relate directly to the CPU type (with a given driver, a 33-MHz 486DX machine can increase an adapter's Winmark score by as much as 25 percent), the test results here are not directly comparable with those

*The 86C924, an
86C911 upgrade, has a
hard time standing its
ground against the
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its siblings.*

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that we published in previous issues.

On PC Labs' Graphics Winmark test, performance generally clustered in groups based on the accelerator chip used, usually with little distinction between EISA and ISA performance. For example, all of the 86C924-based boards—including the single EISA entrant, the Advanced Integration Research Aview 2E—achieved moderate Graphics Winmark scores, ranging from 6.86 to 7.16 megapixels per second in 16-color Super VGA and 1,024-by-768 modes. Only in 256-color modes did the EISA board kick in with noticeably but not significantly higher scores than its 86C924-based ISA peers, which all performed near the bottom of the batch.

The EISA and ISA Windows leaders in Super VGA with 256 colors were the \$799 ATI Graphics Ultra Pro, EISA Version, with a Graphics Winmark score of 15.34, and the \$895 Number Nine #9GXE (an ISA board), which scored 25.74.

The #9GXE's extraordinary Winmark score of 25.74 demonstrates not only the promising ability of S3's 86C928 GUI accelerator but also the significance of software drivers. Five other adapters we looked at use S3's 86C928 chip: In ISA systems, all five achieved Winmark performance ranging from 9.57 to 13.64 at 256-color Super VGA resolution.

The tremendous disparity between these results and the #9GXE's is partly because of that board's additional memory (2MB total), but mainly the result of Number Nine Computer Corp.'s Windows driver, which incorporates text-string caching. This technique is even more controversial than the bitmap caching used by other vendors, as well as Number Nine, because text caching has no perceptible value in real-world applications. Since the #9GXE's Windows driver has been specifically designed to accommodate the Graphics Winmark test, buyers should be aware that the performance gains suggested by the #9GXE's scores probably do not reflect the board's actual conduct in day-to-day Windows applications.

Drivers were again a source of contention with the \$399 Hercules Graphite Card, based on the 16-bit IIT AGX-014 GUI accelerator. This chip-and-driver combination originally posted a Win-

mark score of 14.70 in Super VGA with 256 colors. This was not as remarkably high a score as the Number Nine board's, but we discovered during our testing that the Windows driver provided by Hercules Computer Technology used shortcuts in its display instructions that resulted in high but questionable performance scores. (For more information on the issue of these products' drivers, see the sections "S3's Latest: The 86C928" and "First of the IIT Wave" in the main text, as well as "Driver Optimization Issues" in the benchmark test caption.)

FAST WINDOWS ON THE CHEAP

One group of adapters proved to be particularly attractive price/performance contenders. The boards based on S3's 86C801 accelerator are an excellent choice for anyone in search of better Windows performance on a budget. Designed to work with inexpensive DRAM,

86C801-based adapters list for as little as \$199 (as low as about \$160 on the street) and posted Winmark scores of around 10 to 13 in 256-color Super VGA mode. Particularly noteworthy is the \$249 Orchid Fahrenheit VA, which had a Winmark score of 13.40 for Super VGA 256-color and included a \$50 audio option comprising connections for microphone input and stereo output.

If the 86C801-based boards are still too rich for your PC, adapters based on the Cirrus Logic GD5426, the company's newest GUI accelerator, offer the lowest prices. The Edge D24 BitBlaster Plus is just \$99 (the company sells direct, so don't expect further discounts). But you get what you pay for, and these boards deliver slower Windows performance, hovering around the 4-megapixel-per-second range for 16-color Super VGA and 1,024-by-768, and just edging out the 86C924 products in 256-color modes. Al-

HIGHLIGHTS

Accelerated Graphics Adapters

NEW CHIPS from Cirrus Logic (the GD5426), IIT (the AGX-014), S3 (the 86C928), and Weitek (the W5286) appeared in this review of 32 ISA- and EISA-based graphics accelerators; they join established standards (the ATI Mach 32, Compaq's proprietary accelerator, the S3 86C801, the S3 86C924, and the TI TMS34020).

THIS REVIEW marks a change in PC Labs' test-bed for graphics boards. In order to facilitate comparisons across boards for the ISA, EISA, and VL-Bus standards, we have switched from a 386/25 PC to a 486/33 machine.

THE S3 86C801, which is found on more boards in this review than any other chip, proved the price/performance leader. Boards sell for as low as \$160 on the street, and this chip's Super VGA, 256-color test results in the 10- to 13-megapixel-per-second range sets it above its peers.

FOR SHEER SPEED in the EISA department, the ATI Mach 32-based

ATI Graphics Ultra Pro, EISA Version, is still a leader on our tests; it scored 15.34 megapixels per second in 256-color Super VGA mode. Also, its AutoCAD total time of 54.15 seconds made it the third-fastest board we tested for this story.

AS A CLASS, the S3 86C928-based boards distinguished themselves with fast Windows performance. Most of the boards managed scores of at least 13 megapixels per second in 256 colors. The ISA-based Number Nine #9GXE, however, topped them all with its score of 25.74 megapixels per second in 256-color Super VGA mode, but its driver cached text strings—a controversial move.

IT WOULD HAVE QUALIFIED as one of the fastest ISA-based accelerators, but the Hercules Graphite Card had a driver that circumvented the polylines and overlapping-BitBlt section of our Windows tests, and also built in the text displayed by our Windows Benchmark Tests, Release 3.1.

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CIRCLE 128 ON READER SERVICE CARD

though the GD5426 contains accelerated functions, they are limited: Cirrus's implementation accelerates line draws only on vertical and horizontal lines, for instance. But if Windows isn't your PC's *raison d'être*, you'll appreciate the winning DOS video scores of the boards that use this chip.

Users who spend an equal amount of time in DOS text and Windows applications should also take note of the DOS video scores. Some accelerator chips (such as the 86C911, the 86C924, and the Primus P2000, for example) have not performed well on our DOS video tests in the past, but today strong 86C928- and 86C801-based Windows performers fare substantially better in DOS than these accelerators did.

AUTOCAD CONTENDERS

Choosing a graphics adapter for AutoCAD is more difficult. Because of the importance of AutoCAD display-list drivers, results do not always divide along chip categories. (Display-list drivers contribute to fast pans and zooms by taking the load off the CPU and using adapter memory to store vectors for all lines in a drawing.) Witness the 86C928-based graphics adapters, which range from the fastest AutoCAD performer—the \$495 Artist Graphics WinSprint 900 Lite (53.11 seconds total at 800-by-600 resolution)—to one of the slowest—the \$349 Diamond Stealth Pro (83.52 seconds).

For AutoCAD speed, the performance of the WinSprint 900 Lite's display list processor is attractive. It includes several special features, such as the ability to accelerate the AutoCAD Extension for Windows. On the other hand, the WinSprint 900 Lite turned in the second-slowest Winmark scores for a 86C928-based board and was one of the slower 86C928 performers on DOS video.

WHAT YOU DON'T GET

For all the benefits a GUI accelerator or graphics coprocessor can bring to your PC, these video adapters still have limitations. Though most of the cards in this roundup will deliver photo-realistic 24-bit color (16.7 million colors) at 640-by-480, few will do so in Super VGA (those that do are usually 86C928 boards equipped with 2MB). Only one of the



EDITORS' CHOICE

- **Actix GraphicsEngine Ultra**
- **ATI Graphics Ultra Pro, EISA Version**
- **Orchid Fahrenheit VA**

When *PC Magazine* last reviewed graphics accelerators (January 12, 1993), we predicted that a new generation of boards would soon rise to challenge our Editors' Choice winners and the chips on which they are based. And this is exactly what we found for this

review. Boards based on the S3 86C801 chip have matured to the point where they have overtaken the older S3 86C924-based products, even though the latter have faster VRAM. And as a class, boards based on the new, S3 86C928 chip provided the fastest Windows performance of all the ISA-based products (in 256 color mode at Super VGA and 1,024-by-768).

Boards based on the 86C801 provide the best price/performance ratio, relying on cheaper DRAM to keep costs down; the street prices for most of these boards range from \$160 to \$200. The 86C801-based \$299 Orchid Fahrenheit VA, which comes with an audio option, is a little more expensive than other boards in its class. But with 1MB of RAM and Orchid's stable HyperDriver for Windows, this Editors' Choice winner delivered excellent Graphics Winmark scores in 256-color Super VGA and 1,024-by-768 modes, and it speedily handled our AutoCAD tests, unmarred by remnant pixels or an inability to clear the screen properly—something that plagued a couple of its competitors.

The S3 86C928-based \$329 Actix GraphicsEngine Ultra, another Editors' Choice winner, stands out from the other 86C928-based ISA boards in this review: It has a sturdy design, easy installation, and the most well-rounded performance (for a reasonable cost) of all the 86C928-based boards reviewed here. On our 256-color tests, it was slightly faster than the 86C801-based Orchid Fahrenheit VA. It coupled the best DOS scores of the 86C928 bunch with this group's second-fastest AutoCAD times.

An Editors' Choice goes to the ATI Mach 32-based, \$899 ATI Graphics Ultra Pro, EISA Version, which follows in the footsteps of its ISA sibling. The board proved the fastest of the EISA-based boards, and a top performer of all the reviewed products. You can find it for about \$500 on the street, which is somewhat more expensive than for boards based on the S3 or other chips—but you get speedy DOS results and blazing AutoCAD and Windows performance, and extras such as ATI's crisp, smooth Crystal Fonts and an EEPROM-based configuration.

The EISA version of the Ultra Pro does not suffer from the memory aperture driver problems that beset the ISA version we tested in our issue of January 12, 1993. With 128MB of memory address space available for the EISA version, finding four contiguous megabytes for a linear-addressed display memory space isn't a likely problem.

Some video board vendors continually update their drivers, and ATI ranks among the most prolific; after our review concluded, ATI published what it labeled a beta Release 1.1, Version 55, of its Windows driver set. Frequent updates are a mixed bag: Newer drivers generally run faster, but the revolving-door driver policy can have a less positive impact on correct and predictable driver operation. When vendors spend their time in a never-ending quest to optimize speed, driver reliability may suffer. (Note that we did not see this beta driver, nor did we have any problems with the drivers ATI sent for testing.)

If you don't expect to move beyond 1,024-by-768 with 256 colors, you may

want to look at the ATI Graphics Ultra Pro, ISA Version. ATI claims that this board offers performance comparable to that of the EISA version, at these lower resolutions and color depths, and costs about \$100 less.

CACHING: A SOURCE OF CONTENTION

Vendors may use several forms of caching to improve performance. Bitmap caching (which ATI uses to good effect) has come under fire from some vendors that claim it gives products an edge on our Windows benchmark tests but not in day-to-day use. We believe, however, that bitmap caching *can* provide a performance boost in Windows-based applications: It can speed up everything from dragging and dropping a 64- by 64-bit Windows icon to redrawing a bit-mapped scanned image and then scrolling it around on-screen.

Text caching is a different matter. In this review, the Number Nine #9GXE scored the highest Graphics Winmark scores of any board tested. We cannot award this board an Editors' Choice, however, because the company decided to push the envelope for our Windows Benchmark Tests (Winbench), Release 3.1. Number Nine Computer Corp.'s representatives have expressed the opinion that our approval of bitmap caching technology—a decision the company disagrees with—leaves the field open for manufacturers to devise other ways to boost their boards' benchmark test performance. Number Nine incorporates both bitmap and text-string caching in this board's drivers.

Text-string caching stores a completely rendered text-string bitmap in off-screen memory, delivering a performance boost only with repeated displays of that specific string in the same typeface and point size. But the situations in which you will see such an improvement are practically limited to benchmark tests that use such repeating text strings. Indeed, while text-string caching had a significant impact on a product's Winbench performance, we were unable to perceive a similar im-

pact on application performance. Nor was Number Nine able to offer any real-world scenarios in which we should see a performance improvement.

Don't confuse text-string caching with font caching. *PC Magazine* sees merit in font caching, because it delivers real-world improvements by rendering all letters, numbers, and symbols in a particular typeface and size into bit-mapped form, and then stores them in off-screen graphics memory to be called upon *singly* as needed.

While the #9GXE is otherwise a fine board with some promising features, *PC Magazine* cannot condone the company's decision to circumvent our tests by using drivers optimized for them.

Likewise, Hercules Computer Technology forfeited its chance at winning an Editors' Choice award for its Hercules Graphite Card; the company supplied drivers that did not fully draw overlapping 64- by 64-bit BitBlts and also took a shortcut on the polylines test. The Graphite Card's driver also crossed the line by building in the same text as the text string our Winbench tests display. (The sidebar "Driver Optimization Issues" and the reviews discuss driver optimization in more detail.)

HONORABLE MENTION

The \$495 Artist Graphics WinSprint 900 Lite receives an honorable mention for zipping through our AutoCAD tests, benefiting from a custom display-list processor driver. It proved a worthwhile contender for that environment, but it is less suited to Windows work.

Both Diamond Computer Systems boards—the \$249 86C801-based Diamond Stealth 24 and the \$349 86C928-based Diamond Stealth Pro—produced excellent Graphics Winmark scores. The boards' AutoCAD scores were less impressive, though, and they had minor problems either with artifacts or properly clearing the screen in that environment. Additionally, the Stealth Pro needed a boost to get up to the level of DOS performance most of its 86C928-based peers provided.

adapters we evaluated, the \$929 Metheus Premier 928-4M, takes advantage of the 86C928's ability to accommodate 4MB of RAM to produce 16.7 million simultaneous colors in noninterlaced 1,024-by-768 mode. Most of the vendors that support 24-bit color at all also claim to have drivers for 24-bit color under Windows.

Bear in mind that as color depths and resolutions increase, greater demands are made on these adapters. A GUI accelerator may easily push around the

*While text-string caching
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application performance.*

480K required to display a single screen of 256 simultaneous colors in 800-by-600 mode, but crawl when confronted with the 2.3MB per screen required by 24-bit color in 1,024-by-768 mode.

And the pixel demands won't stop here. Digitized-motion video, such as Microsoft Video for Windows (VFW), can require throughput as high as 30MB per second. A typical ISA PC can handle only about 2.5MB per second. Local-bus video designs such as the VL-Bus help, but in the future, fixed-function accelerators will have to off-load even more calculations from the CPU. Only one accelerator in this roundup, the ATI Graphics Ultra Pro, EISA Version, has begun to make headway in this area by providing some limited enhancements for VFW.

FANCY FEATURES

Several other adapter manufacturers distinguish themselves by including unusual capabilities. The \$548 ELSA Winner 1000 is both an EISA and ISA adapter. Along one edge of the card is a 16-bit ISA connector; along the other edge is a 32-bit EISA interface.

Users who never have a large enough screen should consider The \$995 Colorgraphic Twin Turbo Accelerator. It can

drive two monitors simultaneously, displaying either two screenfuls of the same image or extending a single Windows image over the two monitors. Or you can buy two Premier 928-4M boards and do the same.

Even if you don't need such features, just about anyone who runs Windows but has stuck with that old VGA frame-buffer graphics adapter should start thinking about upgrading. Prices have never been better on EISA and ISA GUI accelerators and coprocessors, and DOS

performance is, on the whole, improving for this bunch. As you read the reviews, remember to focus on the applications you use the most and pick a card that best suits your price/performance needs.

Our reviews are divided by chip category. We begin with the largest single representation of chips—the 86C801-based boards. Following that are reviews of 86C928-based boards; AGX-014-based and proprietary solutions; 86C924-, GD5426-, and W5286-based designs; and TMS34020 coprocessors.

THE S3 86C801 GANG

- Actix GraphicsEngine 32 Plus
- Diamond Stealth 24
- Focus 2 the Max TrueSpeed
- Genoa WindowsVGA 24+
- Metheus Premier 801
- Mirage Storm 1280/256
- Nth S3 Advantage
- **EDITORS' CHOICE** Orchid Fahrenheit VA
- Video Seven WIN.PRO

BY WINN L. ROSCH

Affordable acceleration is what you get when you choose a graphics card based on the S3 86C801 accelerator. For no more than you might pay for last year's Super VGA frame-buffer board, you can buy speedy Windows performance complete with all the resolution you can squeeze out of most reasonably priced monitors.

As little as \$160 (street price) will give you a board that delivers a Graphics Winmark score of about 10 megapixels per second at 800-by-600 and 1,024-by-768 at 16 colors. And at these resolutions with 256 colors, some of the 86C801-based boards provided Winmark scores in the 11- to 13-megapixels-per-second range. You also get 1,280-by-1,024 capability at 16 colors with 1MB (or 256 colors with the optional 1MB most of these boards can support), and as many as 16.70 million colors at 640-by-480 resolution on-screen.

Eight of the nine 86C801-based ISA boards examined here list at about \$249 with 1MB. The remaining one is substantially more expensive—the \$595 Nth S3 Advantage—and most of those extra bucks really buy a feature-laden Auto-

CAD driver (which includes such extras as a file-management and previewing module) rather than improved hardware. The other 86C801-based boards we reviewed are the \$219 Actix GraphicsEngine 32 Plus, the \$249 Diamond Stealth 24, the \$199 Focus 2 the Max TrueSpeed, the \$249 Genoa Windows VGA 24+, the \$299 Metheus Premier 801, the \$295 Mirage Storm 1280/256, the \$299 Orchid Fahrenheit VA, and also the \$249 Video Seven WIN.PRO. On the street, the Diamond, Metheus, Mirage, and Video Seven boards are priced in the \$200 range, making them slightly more expensive there than most of their peers.

The virtues of the 86C801 accelerator include its 32-bit internal architecture (though it connects directly only to the 16-bit ISA bus), its 32-bit path to its display memory, and its support for true color. Additionally, the chip supports a 72-Hz refresh rate at 1,024-by-768 nonin-

terlaced resolution. It manages 60 Hz in 1,280-by-1024 noninterlaced and 43 Hz at 1,280-by-1,024 interlaced modes. (Whether a board will support 1,280-by-1,024 in noninterlaced mode depends on the support chips used; in this roundup, the Genoa WindowsVGA 24+, Nth S3 Advantage, and Orchid Fahrenheit VA support this resolution in interlaced mode only.) To help keep costs down, the 86C801 chip uses inexpensive DRAM—up to 2MB—instead of quicker VRAM.

For EISA and local-bus systems, S3 provides a near-twin to the 86C801—the 86C805; it has the same internal architecture but links to EISA and local-bus PCs with a 32-bit host-bus interface. No EISA-based 86C805 boards were in shape by our test time. The sidebar “The Shape of Boards to Come” offers more information on how local-bus boards using the 86C805 chip fared in comparison with other local-bus offerings.

RANKING THE 86C801

Also related to the 86C801 are S3's 86C924 and 86C928. With 1 MB, the 86C924 ISA-based boards are comparably priced with the 86C801-based boards, even though the 86C924 uses more expensive and faster VRAM. And despite the faster memory, products using the 86C924 chip did poorly in comparison with boards using the 86C801 in PC Magazine Labs' Graphics Winmark tests.

Typically, 86C924-based boards—even those designed for the EISA bus—managed only about 7 megapixels per second in 800-by-600 and 1,024-by-768 modes at 16 colors, and about 5 to 6 megapixels per second at those resolutions with 256 colors. This mirrors the results we found in our

last roundup of accelerator cards. You can partly chalk the slower performance up to factors such as the 86C924's narrower (16-bit) display memory data path and the fact that it has fewer pattern-fill operations than the 86C801.

The 86C801-based boards also typically provided twice the DOS VGA per-

The 86C801's virtues include its 32-bit internal architecture, 32-bit path to display memory, and support for true color.

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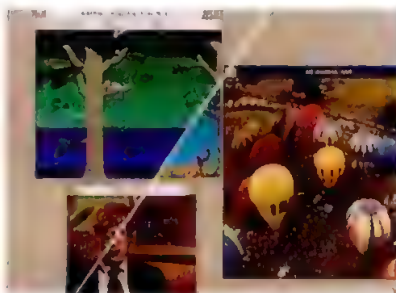
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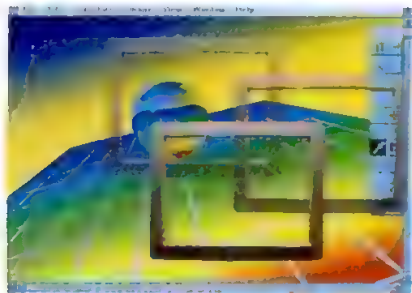


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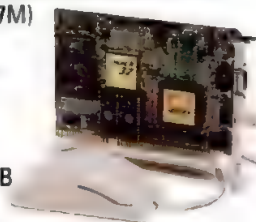
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Benchmark Tests: Graphics Accelerators

The ATI Graphics Ultra Pro, EISA Version, had the best Microsoft Windows scores among the small group of EISA boards we reviewed for this roundup. In fact, its scores were at the top of the entire field of EISA and ISA contenders.

You'll find that most boards using the same chip provided the same level of performance on our Windows test suites, with the S3 86C928-based boards just edging ahead of the S3 86C801-based products on our 256-color tests (particularly at 1,024-by-768 resolution). The boards based on the S3 86C924 chip brought up the rear in the same mode.

How We Tested

At PC Magazine Labs, we tested the 32 ISA and EISA graphics boards we reviewed in a Compaq Deskpro 486/33M equipped with 8MB of RAM, a 310MB ESDI hard disk, Compaq DOS 5.0, Microsoft Windows 3.1, and AutoCAD, Release 11. In almost all cases, we removed the Compaq's standard VGA card before running our tests (the only exceptions were for boards that did not have on-board VGA, like members of the TI TMS34020 series).

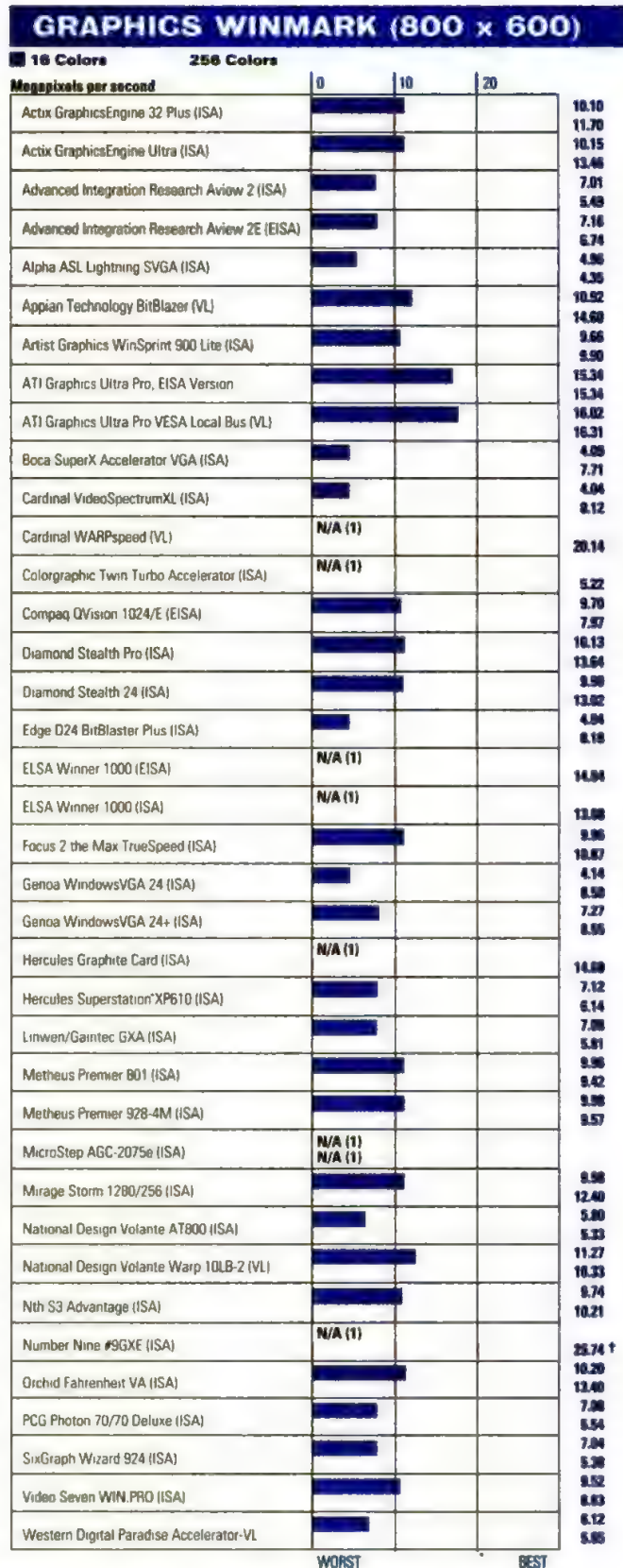
We tested the VL-Bus boards on a Micronics motherboard with 8MB of RAM, in a 486/33 system configured with a 210MB IDE hard disk, MS-DOS 5.0, Microsoft Windows 3.1, and AutoCAD, Release 11. These products are reviewed in the sidebar "The Shape of Boards to Come."

We ran three kinds of tests on the products: the DOS video test routines from our Hardware Benchmark Tests, Release 7.0; the Graphics Winmark routines from our Windows Benchmark Tests (Winbench), Release 3.1; and a set of AutoCAD performance tests.

The **Graphics Winmark** score is a weighted harmonic mean based on 12 Windows graphics and text functions derived from extensive profiling of popular Windows applications. It is measured in megapixels per second (a megapixel is 1,048,576 pixels). For a detailed explanation of our Windows Benchmark Tests, Release 3.1, see Lab Notes, *PC Magazine*, December 8, 1992.

The **AutoCAD** performance test, developed by Chris Delucci of the San Diego AutoCAD Users Group, evaluates the quality of the ADI or display-list processor driver, as well as the vector-generation capabilities of each chip. It measures the total time required to execute a series of AutoCAD commands.

For the Windows accelerators, we report separate scores for four tasks from the AutoCAD test: repeated zooms on fixed text, zooms on an area of random vectors (polygons, polylines, radial patterns, and line entities), zooms



N/A (1)—Not applicable. The product did not have a suitable driver for this test.

GRAPHICS WINMARK (1024 x 768)**16 Colors 256 Colors**

Megapixels per second	0	10	20	
Actix GraphicsEngine 32 Plus (ISA)				9.77
Actix GraphicsEngine Ultra (ISA)				11.76
Advanced Integration Research Aview 2 (ISA)				10.04
Advanced Integration Research Avew 2E (EISA)				13.53
Alpha ASL Lightning SVGA (ISA)				7.22
Appian BitBlazer (VL)				5.75
Artist Graphics WinSprint 900 Lite (ISA)				7.16
ATI Graphics Ultra Pro, EISA Version				6.46
ATI Graphics Ultra Pro VESA Local Bus (VL)				5.30
Boca SuperX Accelerator VGA (ISA)				4.49
Cardinal VideoSpectrumXL (ISA)				11.16
Cardinal WARPspeed (VL)	N/A (1)			15.05
Colorgraphic Twin Turbo Accelerator (ISA)	N/A (1)			10.29
Compaq QVision 1024/E (EISA)				9.95
Diamond Stealth Pro (ISA)				15.19
Diamond Stealth 24 (ISA)				15.15
Edge D24 BitBlaster Plus (ISA)				16.33
ELSA Winner 1000 (EISA)	N/A (1)			16.24
ELSA Winner 1000 (ISA)	N/A (1)			4.41
Focus 2 the Max TrueSpeed (ISA)				5.03
Genoa WindowsVGA 24 (ISA)				4.53
Genoa WindowsVGA 24+ (ISA)				7.52
Hercules Graphite Card (ISA)	N/A (1)			20.77
Hercules Superstation XP610 (ISA)				5.19
Linwen/Gaintec GX4 (ISA)				9.85
Metheus Premier 801 (ISA)				7.86
Metheus Premier 928-4M (ISA)				10.03
MicroStep AGC-2075e (ISA)	N/A (1)			13.86
Mirage Storm 1280/256 (ISA)				10.09
National Design Volante AT800 (ISA)				11.91
National Design Volante Warp 10LB-2 (VL)				4.49
Nth S3 Advantage (ISA)				7.82
Number Nine #9GXE (ISA)				13.84
Orchid Fahrenheit VA (ISA)				13.37
PCG Photon 70/70 Deluxe (ISA)				9.73
SixGraph Wizard 924 (ISA)				10.39
Video Seven WIN PRO (ISA)				4.60
Western Digital Paradise Accelerator-VL				8.29
				7.30
				8.02
				14.8†
				8.27
				7.03
				7.05
				5.67
				10.02
				9.42
				10.04
				9.70
				6.13
				9.62
				12.10
				6.21
				5.11
				10.92
				10.44
				9.82
				8.90
				28.17†
				26.56†
				10.16
				12.61
				7.15
				5.72
				6.86
				5.42
				9.65
				8.39
				5.70
				4.85

WORST

BEST

† Unreliable result. The product bypassed portions of this test

AUTOCAD (TEXT ZOOM)

Seconds	0	10	20	30	40	140	
Actix GraphicsEngine 32 Plus (ISA)							21.53
Actix GraphicsEngine Ultra (ISA)							21.42
Advanced Integration Research Aview 2 (ISA)							20.87
Advanced Integration Research Avew 2E (EISA)							20.65
Alpha ASL Lightning SVGA (ISA)	N/A (1)						
Appian BitBlazer (VL)							20.38
Artist Graphics WinSprint 900 Lite (ISA)							13.13
ATI Graphics Ultra Pro, EISA Version							9.22
ATI Graphics Ultra Pro VESA Local Bus (VL)							9.12
Boca SuperX Accelerator VGA (ISA)							45.42
Cardinal VideoSpectrumXL (ISA)							45.37
Cardinal WARPspeed (VL)							25.27
Colorgraphic Twin Turbo Accelerator (ISA)							27.74
Compaq QVision 1024/E (EISA)							32.46
Diamond Stealth Pro (ISA)							32.46
Diamond Stealth 24 (ISA)							45.37
Edge D24 BitBlaster Plus (ISA)							14.34
ELSA Winner 1000 (EISA)							14.66
ELSA Winner 1000 (ISA)							21.64
Focus 2 the Max TrueSpeed (ISA)							47.73
Genoa WindowsVGA 24 (ISA)							10.99
Genoa WindowsVGA 24+ (ISA)							18.40
Hercules Graphite Card (ISA)	N/A (1)						20.76
Hercules Superstation XP610 (ISA)							21.31
Linwen/Gaintec GX4 (ISA)							21.15
Metheus Premier 801 (ISA)							149.90
Metheus Premier 928-4M (ISA)							13.24
MicroStep AGC-2075e (ISA)							9.50
Mirage Storm 1280/256 (ISA)							14.94
National Design Volante AT800 (ISA)							20.60
National Design Volante Warp 10LB-2 (VL)							15.99
Nth S3 Advantage (ISA)							20.87
Number Nine #9GXE (ISA)							21.70
Orchid Fahrenheit VA (ISA)							46.90
PCG Photon 70/70 Deluxe (ISA)							
SixGraph Wizard 924 (ISA)							
Video Seven WIN PRO (ISA)							
Western Digital Paradise Accelerator-VL							

BEST

WORST

AUTOCAD (VECTOR ZOOM)

Seconds	0	5	10	15	20	
Actix GraphicsEngine 32 Plus (ISA)						5.44
Actix GraphicsEngine Ultra (ISA)						5.28
Advanced Integration Research Aview 2 (ISA)						5.60
Advanced Integration Research Avew 2E (EISA)						5.55
Alpha ASL Lightning SVGA (ISA)	N/A (1)					
Appian BitBlazer (VL)						5.21
Artist Graphics WinSprint 900 Lite (ISA)						2.09
ATI Graphics Ultra Pro, EISA Version						1.84
ATI Graphics Ultra Pro VESA Local Bus (VL)						1.15
Boca SuperX Accelerator VGA (ISA)						5.16
Cardinal VideoSpectrumXL (ISA)						5.17
Cardinal WARPspeed (VL)						1.43
Colorgraphic Twin Turbo Accelerator (ISA)	N/A (1)					
Compaq QVision 1024/E (EISA)						11.15
Diamond Stealth Pro (ISA)						1.97
Diamond Stealth 24 (ISA)						1.97
Edge D24 BitBlaster Plus (ISA)						5.17
ELSA Winner 1000 (EISA)						1.54
ELSA Winner 1000 (ISA)						1.54
Focus 2 the Max TrueSpeed (ISA)						5.55
Genoa WindowsVGA 24 (ISA)						5.27
Genoa WindowsVGA 24+ (ISA)						1.26
Hercules Graphite Card (ISA)	N/A (1)					
Hercules Superstation XP610 (ISA)						1.71
Linwen/Gaintec GX4 (ISA)						5.48
Metheus Premier 801 (ISA)						1.43
Metheus Premier 928-4M (ISA)						1.37
MicroStep AGC-2075e (ISA)						
Mirage Storm 1280/256 (ISA)						1.04
National Design Volante AT800 (ISA)						1.37
National Design Volante Warp 10LB-2 (VL)						1.15
Nth S3 Advantage (ISA)						1.37
Number Nine #9GXE (ISA)	N/A (1)					
Orchid Fahrenheit VA (ISA)						5.28
PCG Photon 70/70 Deluxe (ISA)						4.72
SixGraph Wizard 924 (ISA)						5.38
Video Seven WIN PRO (ISA)						5.49
Western Digital Paradise Accelerator-VL						21.92

BEST

WORST

Fail—The product did not complete this test

AUTOCAD (3-D MODEL ZOOM)

Seconds	0	10	20	30	40	
Actix Graph (C++)						15.60
Actix Graph (C++)						15.43
Actix Graph (C++)						15.10
Advanced integration (C++)						15.00
Alpha ASL - lightweight SVGA (ISA)	N/A (1)					
Appian B iBlazer (VL)						14.41
Appian B iBlazer (VL)						11.31
Appian B iBlazer (VL)						10.27
ATI Graph (C++)						10.11
ATI Graph (C++)						41.91
ATI Graph (C++)						41.91
ATI Graph (C++)						18.13
ATI Graph (C++)	N/A (1)					
ATI Graph (C++)						16.21
ATI Graph (C++)						23.28
ATI Graph (C++)						23.34
ATI Graph (C++)						41.85
ATI Graph (C++)						14.66
ATI Graph (C++)						14.94
ATI Graph (C++)						15.66
ATI Graph (C++)						43.34
ATI Graph (C++)						13.96
ATI Graph (C++)	N/A (1)					
ATI Graph (C++)						17.08
ATI Graph (C++)						15.05
ATI Graph (C++)						17.43
ATI Graph (C++)						17.24
ATI Graph (C++)	Fail					
ATI Graph (C++)						0.99
ATI Graph (C++)						13.62
ATI Graph (C++)						10.82
ATI Graph (C++)						15.77
ATI Graph (C++)	N/A (1)					
ATI Graph (C++)						14.83
ATI Graph (C++)						28.67
ATI Graph (C++)						15.16
ATI Graph (C++)						15.55
ATI Graph (C++)						31.86
	BEST				WORST	

AUTOCAD (REDRAW)

Seconds	0	1	2	3
Amdahl 4860 VLSI ISA				2.29
Amdahl 4860 VLSI ISA				2.20
Amdahl 4860 VLSI ISA				2.14
Amdahl 4860 VLSI ISA				2.09
Amdahl 4860 VLSI ISA	N/A (1)			
Amdahl 4860 VLSI ISA				2.04
Amdahl 4860 VLSI ISA				1.54
Amdahl 4860 VLSI ISA				1.54
Amdahl 4860 VLSI ISA				1.48
Amdahl 4860 VLSI ISA				2.31
Amdahl 4860 VLSI ISA				2.30
Amdahl 4860 VLSI ISA				0.55
Amdahl 4860 VLSI ISA	N/A (1)			
Amdahl 4860 VLSI ISA				1.05
Amdahl 4860 VLSI ISA				1.48
Amdahl 4860 VLSI ISA				1.48
Amdahl 4860 VLSI ISA				2.31
Amdahl 4860 VLSI ISA				2.04
Amdahl 4860 VLSI ISA				2.00
Amdahl 4860 VLSI ISA				2.20
Amdahl 4860 VLSI ISA				2.30
Amdahl 4860 VLSI ISA				2.03
Amdahl 4860 VLSI ISA	N/A (1)			
Amdahl 4860 VLSI ISA				1.21
Amdahl 4860 VLSI ISA				2.09
Amdahl 4860 VLSI ISA				2.09
Amdahl 4860 VLSI ISA				2.09
Amdahl 4860 VLSI ISA	Fail			
Amdahl 4860 VLSI ISA				0.22
Amdahl 4860 VLSI ISA				1.32
Amdahl 4860 VLSI ISA				1.59
Amdahl 4860 VLSI ISA				2.25
Amdahl 4860 VLSI ISA	N/A (1)			
Amdahl 4860 VLSI ISA				2.06
Amdahl 4860 VLSI ISA				2.56
Amdahl 4860 VLSI ISA				2.08
Amdahl 4860 VLSI ISA				2.25
Amdahl 4860 VLSI ISA				1.19
Western Digital Paradise Accelerator VL				

BSI

WORST

N/A(1)—Not applicable. This product did not have a suitable driver for this test.
Fail—The product did not complete this test.

to center in a 3-D model (approximately 500K), and redraws on the same 3-D model. We also report the total time required to complete these tasks along with several other functions.

The **DOS video** score is the weighted harmonic mean of the results of several direct-to-screen test-write and graphics-write tests. Because our test routines do not use drivers or invite software overhead in exercising the VGA circuitry, they accurately represent each video chip's VGA performance.

Driver Optimization Issues

The scores two boards posted were achieved with drivers optimized solely to provide outstanding performance on PC Labs' Winbench test suite. The boards in question were the Hercules Graphite Card, based on the IIT AGX-014 chip, and the Number Nine #9GXE, based on the S3 86C928 chip.

HERCULES GRAPHITE CARD

The Graphite Card was originally shipped with a driver set that bypassed parts of our Microsoft Windows benchmark tests: It did not draw overlapping 64- by 64-bit BitBlts, nor did it complete the polylines test. In addition, Hercules Computer Technology actually built into its driver the line of text used for the text test within our Winbench suite; rather than rendering text for this test as it should, it merely blit the built-in text onto the screen. The memory-to-screen BitBlt test opens several on-screen windows on top of each other. The Graphite Card bypassed the overlapping aspect of this test by drawing only the visible portions of the 64- by 64-bit BitBlt and not redrawing the shared portions. On the polylines test, the Graphite Card failed to draw the required several line segments multiple times; instead, this board drew only one line.

A second driver Hercules sent for testing removed the overlapping BitBlt optimization, and we report the results achieved with that driver. (These results differed only minimally from the results we observed with the first driver).

Our conclusion: The scores achieved by the Graphite Card on our Windows tests cannot be viewed as legitimate.

NUMBER NINE #9GXE

The Number Nine #9GXE employs text-string caching in addition to bitmap caching (the latter is a feature found in other vendors' accelerator products, including the ATI Graphics Ultra Pro, EISA Version). While bitmap caching can provide a quick and effective way to manipulate multiple open windows and facilitate image cutting and pasting, text-string caching simply takes advantage of the fact that our Winbench tests display the same string of text multiple times. This feature of text-string caching seems to have no bearing on real-world performance.

Besides running our standard Winbench tests, PC Labs ran the boards submitted by ATI and Number Nine through an internal suite of applications. We found that the ATI product's bitmap caching indeed provided slightly better

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AUTOCAD (TOTAL TIME)

Seconds	0	40	80	120	160	
ATI Graphics Pro 128MB (ISA)						71.52
ATI Graphics Pro 128MB (VGA)						72.55
ATI Graphics Pro 128MB (VGA) 2 (ISA)						78.12
ATI Graphics Pro 128MB (VGA) 2 (VGA)						83.55
ATI Graphics Pro 128MB (VGA) 2 (VGA) 2 (ISA)	N/A (1)					
ATI Graphics Pro 128MB (VGA) 2 (VGA) 2 (VGA)						88.97
ATI Graphics WinSprint 900 Lite (ISA)						93.11
ATI Graphics Ultra Pro, EISA Version						94.15
ATI Graphics Ultra Pro VESA Local Bus (VL)						93.11
Boca SuperX Accelerator VGA (ISA)						144.23
Boca SuperX Accelerator VGA (VGA)						142.96
Boca SuperX Accelerator VGA (VGA) 2 (ISA)						85.43
Boca SuperX Accelerator VGA (VGA) 2 (VGA)	N/A (1)					
Boca SuperX Accelerator VGA (VGA) 2 (VGA) 2 (ISA)						83.67
Boca SuperX Accelerator VGA (VGA) 2 (VGA) 2 (VGA)						83.52
Diamond Stealth 24 (ISA)						83.52
Edge D24 BitBlaster Plus (ISA)						142.93
ELSA Winner 1000 (ISA)						77.06
ELSA Winner 1000 (VGA)						78.26
Focus 2 the Max TrueSpeed (ISA)						88.28
Focus 2 the Max TrueSpeed (VGA)						146.43
Focus 2 the Max TrueSpeed (VGA) 2 (ISA)						53.74
Focus 2 the Max TrueSpeed (VGA) 2 (VGA)	N/A (1)					
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (ISA)						74.05
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA)						83.71
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						74.85
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA)						75.85
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)	N/A (1)					
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						158.52
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						86.58
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						49.58
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						73.17
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)	N/A (1)					
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						88.31
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						88.15
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						68.94
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						72.23
Focus 2 the Max TrueSpeed (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (VGA) 2 (ISA)						189.89

BEST
WORST

N/A (1)—Not applicable: The product did not have a suitable driver for this test.

performance on this test suite than was available with its caching turned off. But the Number Nine accelerator board provided the same level of performance whether or not its cache was activated, indicating that while text-string caching

formance of their 86C924-based counterparts; the ISA-based Actix Graphics Engine 32 Plus was the top 86C801-based DOS performer, with a score of 4.30 million operations per second. The closest 86C924-based performer was the ISA-based Linwen/Gaintec GXA, with a score of 2.08 million operations per second. We saw few differences between the chip classes on AutoCAD performance; both performed well overall.

The 86C801 boards turned in DOS speeds similar to—even a little faster than—the more costly 86C928-based boards, which hover in the \$400 to \$500 list price range (with 1MB). In the 86C928 and the 86C801, S3 incorporates a dual-address bus for DOS text mode; the 86C801 adds a scheme to reduce wait states. In all cases where a company supplied both an 86C801- and an 86C928-based board for testing (Actix Corp., Diamond Computer Systems, and Metheus

Corp.), the 86C801 board provided the faster DOS performance of the two.

The 86C801 boards demonstrate that this accelerator is edging closer to the traditionally fast DOS performance achieved by dumb frame buffers. For comparison, we informally tested Cirrus Logic GD5422 frame buffer-based boards from Aamazing Technologies (the \$179 Aamazing VGA 1000) and Sigma Designs (the \$429 WinStorm), which managed scores of about 4.70 million operations per second.

When running Windows, the 86C801 boards' performance generally matched most of the 86C928-based boards in 16-color modes, but a greater percentage of 86C928-based boards than 86C801-based boards produced scores in the 13-or-better megapixel-per-second range in 256-color modes. Outside of these two chip classes, only two chip types—most notably, the \$899 EISA-based ATI Graphics

DOS VIDEO

Millions of operations per second	0	2	4	6	
Actix Graphics Engine 32 Plus (ISA)					4.30
Alfa Graphics Engine 32 Plus (ISA)					4.18
Alfa Graphics Engine 32 Plus (ISA)					1.67
Alfa Graphics Engine 32 Plus (ISA)					1.77
Alfa Graphics Engine 32 Plus (ISA)					3.46
Alfa Graphics Engine 32 Plus (ISA)					0.51
Alfa Graphics Engine 32 Plus (ISA)					3.86
Alfa Graphics Engine 32 Plus (ISA)					4.36
Alfa Graphics Engine 32 Plus (ISA)					7.30
Alfa Graphics Engine 32 Plus (ISA)					6.34
Alfa Graphics Engine 32 Plus (ISA)					6.61
Alfa Graphics Engine 32 Plus (ISA)					3.05
Alfa Graphics Engine 32 Plus (ISA)					4.76
Alfa Graphics Engine 32 Plus (ISA)					1.08
Alfa Graphics Engine 32 Plus (ISA)					3.29
Alfa Graphics Engine 32 Plus (ISA)					4.95
Diamond Stealth Pro (ISA)					3.69
Edge D24 B tBlaster Plus (ISA)					4.28
Edge D24 B tBlaster Plus (ISA)					6.62
Edge D24 B tBlaster Plus (ISA)					4.63
Edge D24 B tBlaster Plus (ISA)					4.13
Edge D24 B tBlaster Plus (ISA)					4.14
Edge D24 B tBlaster Plus (ISA)					6.04
Edge D24 B tBlaster Plus (ISA)					2.93
Edge D24 B tBlaster Plus (ISA)					1.62
Edge D24 B tBlaster Plus (ISA)	N/A (2)				
Edge D24 B tBlaster Plus (ISA)					2.88
Metheus Premier 801 (ISA)					3.96
Metheus Premier 801 (ISA)					3.04
Metheus Premier 801 (ISA)	N/A (2)				
Metheus Premier 801 (ISA)					4.23
National Design Volante AT800 (ISA)	N/A (2)				
National Design Volante Warp 10LB-2 (VL)					6.31
Nth Di Advantage A					3.51
Number Nine #9GXE (ISA)					4.19
Orchid Fahrenheit VA (ISA)					4.23
PCG Photon 70/70 Deluxe (ISA)					1.93
SixGraph Warrior 4 (ISA)					2.02
Video Seven WIN PRO (ISA)					3.99
Western Digital Paradise Accelerator-VL					6.57

WORST
BEST

* Reported for comparison.

N/A (2)—Not applicable: This product had no on-board VGA.

is a fine way to up your benchmark test scores, it doesn't really boost real-world performance. Thus the Number Nine #9XGE board's results on our Windows tests can only be viewed in a skeptical light.

Ultra Pro and its Mach 32 accelerator—proved quicker than the 86C801 group when running Windows. So if you are looking for fast Windows performance but have to stick to a budget, you'll find your best choices come with the 86C801.

LEADER OF THE PACK

The leader of the pack is the Orchid Fahrenheit VA, even though it does not accelerate raster operations or image transfers, nor does it do font caching. Priced at \$299 with 1MB of RAM (no street discount), it achieves 13.40 megapixels per second at 800-by-600 and 12.61 at 1,024-by-768 in 256-color mode on our Graphics Winmark tests, better than many more-costly boards. At 16 colors, it racked up 10.20 and 10.16 megapixels per second in these resolutions, respectively. The board we tested came with Orchid Technology's own HyperDriver for Windows that lets you bypass the Windows



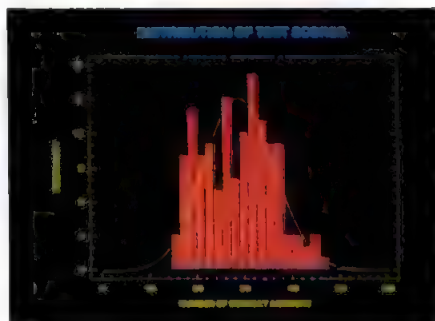
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Graphics Adapters

setup to set resolution and color depth. It also includes Orchid's \$50 audio option that provides a monophonic microphone input, stereo speaker outputs, and Orchid's Voice Notes utility to help turn your PC into a multimedia system.

For one of the least-expensive 86C801 entries, try the 80-MHz RAMDAC version of the Actix GraphicsEngine 32 Plus (\$199 list, or around \$160 on the street). The 110-MHz version we tested (\$219) had impressive speed: 11.70 and 11.76 megapixels per second at 256 colors in 800-by-600 and 1024-by-768 respectively, and 10.10 and 9.77 at those respective resolutions with 16 colors. The only difference between the two versions is that the 110-MHz RAMDAC version adds support for noninterlaced 1,280-by-1024 resolution. (But note that the Actix board is only FCC-Class A rated.) Another low-priced candidate is Focus Information Systems' Focus 2 the Max TrueSpeed (\$199 with 1MB, or \$179 on the street), which delivers approximately equivalent Winmark numbers at 16 colors and is only slightly slower than the Actix unit in 256-color modes; the Focus board has a 110-MHz RAMDAC.

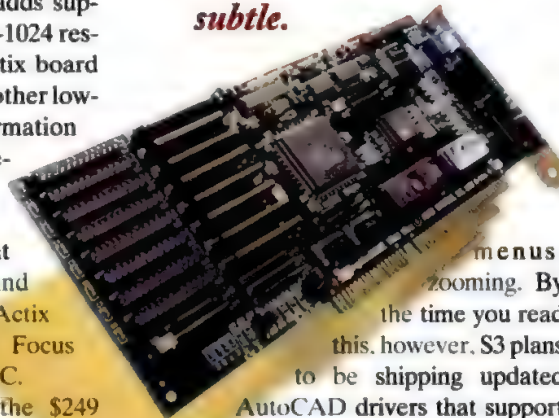
On our AutoCAD tests, the \$249 Genoa WindowsVGA 24+ proved the quickest 86C801-based solution. It raced through our evaluation as the second fastest of all boards in this survey (total time, 53.74 seconds). Most of the other 86C801 boards performed somewhat slower than the Genoa WindowsVGA 24+ on AutoCAD, delivering total test times of around 65 to 75 seconds. The Diamond Stealth 24 lagged a bit with a score of 83.52 seconds. The Mirage Storm 1280/256 suffered during text zooms, for a laggardly total score of 158.52 seconds.

All makers of these 86C801-based boards offer AutoCAD drivers that meet the ADI 4.2 standard. Three of the manufacturers rely on AutoCAD drivers supplied by S3: Actix, Focus Information Systems, and Video Seven. The Genoa board's impressive score was aided by Graphic Software Labs' Mach 12 AutoCAD driver. Metheus Corp. includes its own AutoPlus (Release 4.0) driver, which incorporates true display-list editing, a useful capability. Diamond and Orchid both license drivers from Panacea,

and Mirage Computer Systems and Nth supply their own drivers. Relying on S3's basic driver doesn't have to be a performance handicap.

The second-fastest of these nine boards on our AutoCAD tests was the Focus 2 the Max TrueSpeed. By opting for third-party drivers instead of the S3 versions, though, you'll get extra convenience features—bird's-eye views, panning, pop-up

The actual hardware differences among these 86C801 boards are subtle.



menus, zooming. By the time you read this, however, S3 plans to be shipping updated AutoCAD drivers that support these features.

Only two products showed rough edges when running AutoCAD. The Diamond Stealth 24 running its Panacea TurboDLD Deluxe Driver failed to clear the screen properly during some tests. Remnant pixels also marred the otherwise exemplary performance of the Genoa WindowsVGA 24+.

CONSISTENT DESIGN

The consistent performance among these 86C801-based boards partly results from their nearly identical hardware designs. Most of the board vendors also rely on S3's own drivers for applications such as Windows 3.1, although they usually tweak or rewrite them in order to optimize display speed. Diamond with its TurboWindows, Orchid with its HyperDriver, and Nth with its proprietary set of Windows drivers are three vendors who provided enhanced Windows drivers. (OS/2 2.0 drivers for 800-by-600 and 1,024-by-768 resolution are just becoming available from S3.)

The actual hardware differences we found among these 86C801 boards are subtle and not meaningful to overall video performance. For example, while the Actix, Genoa, Metheus, and Orchid boards use a Chrontel chip to derive their clocks, Nth Graphics and Video Seven use an Avasem chip. Diamond uses its own clock chip.

In memory, too, you'll find little variation among the products we review. The 86C801 specifications require 70-ns DRAM, and Actix, Focus, and Genoa Systems Corp. equip their boards with exactly that. Diamond, Metheus, Mirage, Nth, Orchid, and Video Seven opt for quicker 60-ns chips on their boards.

Memory quantity has one important implication. More memory increases the number of colors a board can simultaneously put on your monitor screen. Boards equipped with 2MB—in this roundup, the Mirage Storm 1280/256—can paint up to 65,536 hues at 1,024-by-768 resolution. With 1MB, the best that any product can manage is 256 colors at that resolution.

Focus and Mirage sell both 1MB and 2MB versions of their products. Actix, Genoa, Metheus, and Video Seven equip their products with 1MB but provide the sockets for you to install another 1MB; they don't sell additional DRAM. The other three of these 86C801-based boards—Diamond, Nth, and Orchid—limit you to 1MB.

Color choice is also controlled by the DAC used by a video card. All but one of the 86C801-based boards we tested use AT&T's 20C491 chip. Only Diamond opted for its own proprietary RAMDAC chip. For this review, Actix, Focus, Metheus, Mirage, and Video Seven supplied boards that use 110-MHz parts; Genoa, Nth Graphics, and Orchid installed 80-MHz versions.

All of these boards will deliver a 72-Hz refresh rate at resolutions of 800-by-600 or less. At 1,024-by-768, all these boards offer a maximum refresh rate of either 70 or 72 Hz, independent of DAC speed. Most of the boards differ in how they let you alter the refresh rate and make other setup adjustments.

Actix, Metheus, and Nth let you select the refresh rate of higher resolutions with a DIP switch (which can be operated

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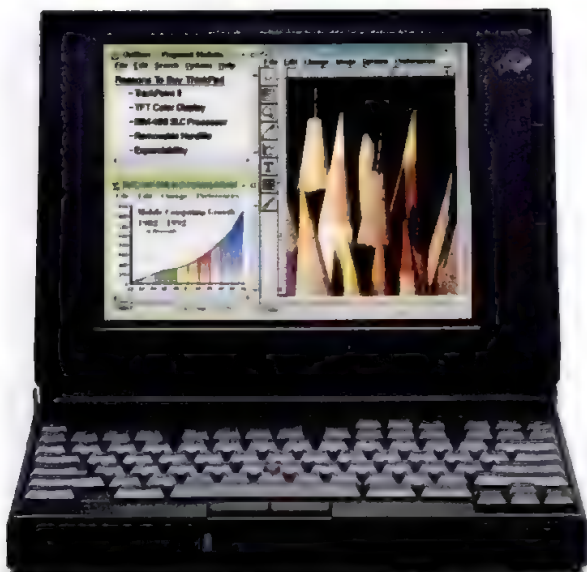
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■ New Accelerator Chip from Matrox on the Horizon

by James Karney

Add another accelerator chip to the growing list of Microsoft Windows speed-up solutions already on the market. Matrox, a company known for its high-end true-color display adapters like the TI TMS34020—based Impression AT-S, has developed a new high-performance graphics accelerator chip. Matrox's MGA (Multimedia Graphics Architecture) series of boards based on a proprietary chip set are expected to ship in volume early in May. The company also expects to make the chip available to other vendors.

Like the ATI Mach 32, the Avance ALG2201, and the S3 86Cxxx family, the Matrox chip accelerates common graphics functions such as BitBlts and pattern, polygon, and rectangle fills. But in many ways the Matrox design goes beyond current accelerator offerings. For instance, it also accelerates advanced CAD functions like 3-D Gouraud shading, z-buffering, and character drawing.

These and other features of the chip set hint that Matrox is positioning its MGA products as low-cost PC alternatives to dedicated graphics workstations. The Matrox chip is optimized for 486-based and Pentium systems, and with enhancements for Intel's PCI (Personal Computer Interconnect) local-bus specification in mind. It has a 128-bit-wide bus, with 64 bits for graphics and 64 bits for video output. The 64-bit graphics bus is twice as wide as most existing adapters. Boards based on the Matrox chip will take full advantage of the 64-bit block-write capability of VRAM, and sport a 32-bit multiplexed bus-host interface. Although it handles 64-bit instructions internally, the Mach 32 chip cannot handle 64-bit block writes.

While MGA prototype boards were not ready for testing when we

wrote this article, the Matrox chip set's wider internal bus and 64-bit block-write capability could translate into performance that is as much as 12 times as fast as most existing Windows accelerators.

Other additions and innovations for this chip include a direct interface to a laser printer to accelerate printing, video windowing capabilities, animation acceleration, and 32-bit-per-pixel support.

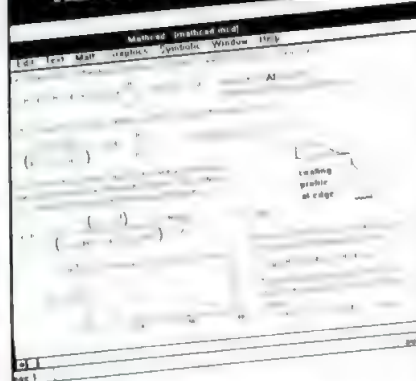
All versions of the MGA will have VGA on-board, and all will support 24-bit true color. The \$849 ISA-based MGA Ultima Pro comes with 2MB of RAM and supports 24-bit color at 800-by-600, and 256 colors at its maximum resolution of 1,280-by-1,024. The \$1,299 MGA Ultima 1600 differs from the Ultima Pro only in that it supports a 1,600-by-1,200 resolution at a maximum of 16-bit colors. The top-of-the-line, ISA-based MGA Impress AT sells for \$1,299 with 3MB of RAM and supports 24-bit color at 1,024-by-768, although it supports up to 1,280-by-1,024 with fewer colors.

Initial boards will offer ISA, MCA, or VL-Local bus connections. PCI, EISA, and S-bus (Sun SPARC workstations) products are under development. There will be drivers for Windows 3.1 and Windows NT (including Open GL), OS/2 2.x, DynaView ADI/AutoCAD, and SunSoft Solaris 2.0. Also bundled with the cards will be a JPEG compression utility for Windows, a ClearType anti-aliasing utility, and mode-switching software.

Options planned for the MGA series take advantage of the design's high throughput. VideoPro is a daughtercard NSTC/PAL encoder that can provide desktop- or broadcast-quality TV video output. All versions of the MGA chip will be compatible with the \$995 Matrox Marvel video-in-a-window board. □

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PCM92

■ The Shape of Boards to Come

by John R. Quain

This initial sampling of five VESA local-bus graphics adapters proves that even the ablest EISA and ISA GUI accelerators cannot overcome the fixed speed of the expansion bus.

On a standard EISA or ISA PC, all components or their controllers sit on one of two electrical paths: the synchronous local system bus (system memory and main controller logic) or the asynchronous expansion bus (drive controllers, modems, and most else). This has traditionally made sense: There was no advantage to improving the performance of slower-running peripheral boards that could not transfer enough data to saturate the expansion bus. But the data traffic of some peripherals—particularly today's graphics adapters—has outgrown what the standard 16-bit, 8-MHz ISA expansion bus will bear.

Putting a video controller on the local 32-bit data path of a 486DX CPU running at the processor's full clock speed—33 MHz, for example, versus the 8.33-MHz expansion bus—can rejuvenate GUIs such as Microsoft Windows. Last fall, the Video Electronics Standards Association (VESA) released a local-bus spec dubbed the VL-Bus: an extension to EISA and ISA PC architecture providing a local-bus interface standard for up to three local-bus peripherals.

In ISA VL-Bus PCs, the local-bus slots have a 32-bit MCA-style connector that sits in line with the standard 16-bit ISA expansion slot. (VL-Bus peripherals can hook into the local bus via the 112-pin MCA-style connector at one end and into a standard ISA connector at the other.) To test the performance gains of the VL-Bus design, PC Magazine Labs used a Micronics VL-Bus motherboard with a 33-MHz 486DX CPU to conduct AutoCAD, DOS video, and Graphics Winmark tests. (You can find the benchmark results for these boards charted along with the EISA and ISA boards.) The five video

peripherals we looked at for the VL-Bus are the \$325 Appian Technology BitBlazer, the \$799 ATI Graphics Ultra Pro VESA Local Bus (with 2MB VRAM), the \$799 Cardinal WARPspeed (with 2MB VRAM), the \$399 National Design Volante Warp 10LB-2, and an OEM prototype of the Western Digital Paradise Accelerator-VL (with 1MB DRAM). The Paradise will be available through Western Digital's licensees under various brand names, and should sell for around \$229.

The Cardinal WARPspeed garnered top local-bus Winmarks in 256-color Super VGA and 1,024-by-768 modes with 20.14 and 20.77 megapixels per second, respectively. The first board using the Weitek Power 9000 chip to be tested by PC Labs, the WARPspeed boasts a full array of GUI functions, such as BitBlting, a hardware cursor, line drawing, and rectangle fills. With a 32-bit I/O interface, the Power 9000 controller takes full advantage of its local-bus position, including the use of linear addressing. But Cardinal Technologies' implementation of Weitek's design uses a Weitek W5186 controller with 512K of DRAM for VGA compatibility; this underpowered section hurt the board's non-GUI performance.

Second place among the local-bus boards for Windows went to the ATI Graphics Ultra Pro VL-Bus, which also tied with an ISA-based design for the second-fastest time under AutoCAD and led the DOS video field. With 2MB of VRAM, the Graphics Ultra Pro VL-Bus uses the same Mach 32 controller as the ISA-based ATI Graphics Ultra Pro and Graphics Ultra Pro EISA. The

chip, which has a full 32-bit I/O interface and can handle 64-bit instructions internally, exploits such performance-enhancing features as area fills, a hardware cache, a hardware cursor, and line draws. Through software, users can set a linear addressed display memory or "memory aperture" of up to 4MB.

The National Design Volante Warp10 LB 2 and the Appian BitBlazer are both based on the S3 86C805 chip, the local-bus version of the S3 86C801. With the same basic chip architecture and accelerated functions as the 86C801, the 86C805 adds a 32-bit I/O interface for the local bus.

The Volante Warp10LB 2 placed behind many of the EISA and ISA 86C928- and 86C801-based boards in

Super VGA mode with 256 colors, but was fourth overall in 1,024-by-768 mode with 16 colors and earned first place overall on AutoCAD testing. On the DOS video test, it placed eighth.

The 86C805-based Appian BitBlazer did better in Windows, tying for fourth place on Graphics Winmark

in 800-by-600 mode with 256 colors; it came in sixth on DOS video. But its AutoCAD driver was not as efficient as NDI's, earning it tenth place among all the cards tested. Appian sells the BitBlazer with 1MB of DRAM for \$325 (\$395 with 2MB).

LAST ON THE LOCAL BUS

Simply plugging an accelerator into the VL-Bus does not guarantee superior performance, however. For instance, the Western Digital Paradise trailed not only the other VL-Bus cards, but most of the cards we tested. Based on West-

*The VL-Bus standard
may have some
competition from the
Intel Peripheral
Component
Interconnect (PCI)
architecture.*

Graphics Adapters

ern Digital's WD90C31 controller—whose 16-bit interface reveals that it was not originally designed for the local bus—and using 1MB of DRAM, the accelerator lacks line draws, but supports functions such as a hardware cursor, linear addressing, pattern fill, and raster operations. The Paradise placed second to last in Winmark testing at 256 colors in Super VGA and 1,024-by-768 modes, and its AutoCAD results were dead last. On the DOS video test, however, the Paradise unit placed fifth overall.

NOT THE ONLY ONE

The VL-Bus standard may have some competition from Intel's Peripheral Component Interconnect (PCI) architecture. Although Intel's approach is slightly different—and currently incompatible with the VESA design from both a buyer's and peripheral maker's point of view—the performance benefits promise to be similar. Preliminary PCI designs, intended to uncouple the CPU from the expansion bus and thus free up both sides of the equation, look promising. Buyers may soon face more local-bus options than they'd care to. Most vendors plan to support PCI and VL-Bus systems—until a clear market winner is declared. □

Appian Technology Inc., 477 North Matilda Ave., Sunnyvale, CA 94088-3410; 800-727-7426; 408-730-5400.

Circle 539 on reader service card

ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, ON, CD, M1W 3S2; 416-756-0718.

Circle 540 on reader service card

Cardinal Technologies Inc., 1827 Freedom Rd., Lancaster, PA 17601; 717-293-3000.

Circle 541 on reader service card

National Design Inc., 1515 Capital of Texas Hwy. South, fifth floor, Austin, TX 78746; 800-253-8831.

Circle 542 on reader service card

Western Digital Corp., 8105 Irvine Center Dr., Irvine, CA 92718; 714-932-4900.

Circle 543 on reader service card

through the retaining bracket of the board while it is installed in your PC). Actix starts with a preset VESA 72Hz at 800-by-600 and allows you to change the refresh rate only at higher resolutions (1,024-by-768 and 1,280-by-1024).

Video Seven sets its refresh through software, requiring you to run a small utility to kick up the frequency each time you boot up your PC. On the positive side, this technique allows you to tweak the refresh rate on the fly.

Genoa also uses software and provides an elaborate menu-driven front-end—one which crashed regularly during

evaluation. On the other hand, command-line utilities duplicate the functions of the front end and worked reliably. Note that Genoa requires you to set the refresh individually for each higher resolution, while Video Seven sets one refresh for all resolutions.

Our evaluations show the S3 86C801 to be the best choice for affordable acceleration today. Although Windows speed alone makes almost any of these 86C801-based boards a good choice, their price/performance ratio is without peer—especially since they deliver their results in ISA computers.

S3'S LATEST: THE 86C928



- Actix Graphics-Engine Ultra
- Artist Graphics WinSprint 900 Lite

- Diamond Stealth Pro
- ELSA Winner 1000
- Metheus Premier 928-4M
- Number Nine #9GXE

BY BRUCE BROWN



S3 Corp.'s latest entry in the accelerator race is the S3 86C928. As a group, products based on this chip prove to be among the front-runners in the S3 product line. Indeed, in terms of Windows performance, they have few competitors among all the reviewed boards that are based on other vendors' accelerator or coprocessed chips.

With a maximum of 4MB of VRAM, the fully VESA-compatible 86C928 chip offers true-color support for resolutions up to 1,024-by-768 and a maximum resolution of 1,600-by-1,200 noninterlaced at 16-bit color. With 1MB of VRAM, you can achieve 16.7 million colors in VGA mode, 64K colors in Super VGA mode, or 16 colors at 1,280-by-768. Another feature of the 32-bit chip is its linear address mapping for faster memory-to-screen operations. Its shared memory architecture will allow it to support hooks to a video coprocessor for full-motion video.

Six vendors shipped accelerator boards with 86C928 chips in time for our testing. The boards are: the \$329 Actix GraphicsEngine Ultra, the \$495 Artist Graphics WinSprint 900 Lite, the \$349

Diamond Stealth Pro, the \$548 ELSA Winner 1000 (which flips to support either the EISA and ISA bus in a single card), the \$929 Metheus Premier 928-4M, and the \$495 Number Nine #9GXE.

All the boards we reviewed included 1MB of VRAM, except for the Metheus and Number Nine boards, which came with 4MB and 2MB, respectively; 2MB versions are available for all boards. Half of the products use 80-ns VRAM; the Metheus and Number Nine boards use faster 70-ns VRAM, and the Diamond board relies on 60-ns memory.

We found the high-refresh 24-bit Brooktree 485 RAMDAC on the #9GXE and Premier 928-4M; the 24-bit AT&T C491 sits on the Artist and Actix offerings. (S3 had not completed 24-bit drivers for the 86C928 that support the Brooktree 485 RAMDAC in time for our testing. Metheus makes its own 24-bit color drivers for the Premier; Number Nine Computer Corp. expects to have released 24-bit color drivers by the time you read this.)

The ELSA Winner 1000 uses a 24-bit Sierra 15025CV RAMDAC from Sierra Semiconductor. The Diamond Stealth Pro we saw uses Diamond Computer Sys-

► **S U M M A R Y O F F E A T U R E S**

Accelerated Graphics Adapters

Products listed in alphabetical order

■ = YES □ = NO



	Actix GraphicsEngine 32 Plus	Actix GraphicsEngine Ultra	Advanced Integration Research Aview 2	Advanced Integration Research Aview 2E	Alpha ASL Lightning SVGA	Artist Graphics WinSprint 900 Lite
List price	\$219	\$329	\$250	\$300	\$199	\$495
Graphics accelerator chip	S3 86C801	S3 86C928	S3 86C924	S3 86C924	Weitek W5286	S3 86C928
VGA BIOS manufacturer	Quadtel	Actix	AMI	AMI	Quadtel	Quadtel
VGA pass-through connector	Dual-pin	Dual-pin	Dual-pin	Dual-pin	Dual-pin	Dual-pin
Hardware cursor	■	■	■	■	□	■

Display Characteristics

Maximum graphics resolution:						
Noninterlaced	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024
Interlaced	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,280 x 1,024
Maximum text resolution	132 x 43	132 x 43	132 x 43	132 x 43	132 x 66	160 x 128
Maximum number of colors at each resolution:						
1,280 x 1,024 noninterlaced	16	16	N/A	N/A	N/A	16
1,280 x 1,024 interlaced	16	16	16	16	N/A	16
1,024 x 768	256	256	256	256	256	256
800 x 600 (Super VGA)	65,536	65,536	256	256	32,768	65,536
VESA support	BIOS	BIOS	BIOS	BIOS	BIOS	BIOS
Display memory (tested unit)	1MB 70-ns DRAM	1MB 80-ns VRAM	1MB 80-ns VRAM	1MB 80-ns VRAM	1MB 70-ns VRAM	1MB 80-ns VRAM
Maximum installable memory	1MB DRAM	2MB VRAM	1MB VRAM	1MB VRAM	1MB VRAM	2MB VRAM
RAMDAC	AT&T C491	AT&T C491	AT&T C491	AT&T C491	Sierra 15025CV	AT&T C491
Virtual display	■	□	□	□	□	■

Included Software Drivers

8514/A	□	□	□	□	□	□
AutoCAD:						
Protected-mode ADI driver	■	■	■	■	□	■
Display list processor	■	□	■	■	□	■
Other CAD programs	■	■	■	■	□	■
Lotus 1-2-3	■	■	■	■	■	■
OS/2 Presentation Manager version	2.0	2.0	None	None	None	None
Ventura Publisher (GEM)	■	■	■	■	■	■
WordPerfect/Microsoft Word	□ ■	■ ■	■ □	■ □	■ ■	■ ■

Customer Support

Toll-free technical support	□	□	□	□	□	■
Technical support hours (eastern time)	11:30–8:30 M–F	11:30–8:30 M–F	11:00–8:00 M–F	11:00–8:00 M–F	11:00–8:00 M–F	10:00–7:00 M–F
BBS	■	■	■	■	■	■
Warranty	1 year	1 year	1 year	1 year	2 years	5 years

N/A—Not applicable. The product does not have this feature.

AMI—American Megatrends Inc., IIT—Integrated Information Technology

HARDWARE

Graphics Adapters

CONTINUES



ATI Graphics Ultra Pro, EISA Version	Boca SuperX Accelerator VGA	Cardinal Video-SpectrumXL	Colorgraphic Twin Turbo Accelerator	Compaq QVision 1024/E
\$899	\$295	\$249	\$995	\$375
ATI Mach 32	Cirrus Logic GD5426	Cirrus Logic GD5426	S3 86C924 (two)	C128084-004
ATI	Boca	Cirrus	Colorgraphic/S3	Compaq
Dual-pin	Dual-pin	Dual-pin	Dual-pin (two)	Edge
■	■	■	■	■

1,280 x 1,024	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768
1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	N/A
132 x 43	132 x 43	132 x 43	132 x 60	132 x 60
256	N/A	N/A	16	N/A
256	16	16	16	N/A
16.7 million	256	256	256	256
16.7 million	65,536	65,536	256	65,536
TSR (4K)	BIOS	BIOS	BIOS	BIOS
2MB 80-ns VRAM	1MB 70-ns DRAM	1MB 45-ns DRAM	2MB 80-ns VRAM	1MB 80-ns VRAM
2MB VRAM	1MB DRAM	1MB DRAM	2MB VRAM	1MB VRAM
TI TLC34075	Integrated on accelerator chip	Integrated on accelerator chip	Brooktree 471KP	Brooktree 484KP
■	□	□	■	□

■	□	□	□	□
■	■	■	□	■
■	■	■	□	■
■	■	■	□	□
■	■	■	□	□
1.x 2.0	2.0	None	2.0	Compaq OS/2 1.21, IBM OS/2 1.3
■	■	■	□	□
■ □	□ □	□ □	□ □	□ □

□	□	□	□	■
9:00-5:30 M-F	8:00-6:00 M-F	8:00-5:00 M-F	8:00-5:00 M-F	24 hours a day, 7 days a week
■	■	■	■	■
5 years	5 years	Lifetime on parts, 1 year on labor	1 year	3 years

tems' own 24-bit SS2410 RAMDAC; a \$150 upgrade option includes another 1MB of VRAM for 1,280-by-1,024 at 256 colors and a Brooktree 485 RAMDAC. ELSA America, Diamond, and Number Nine each write their own Windows drivers. None of the products in this group came with OS/2 drivers because S3 had not made them available in time for our testing. Most of the vendors in this section expect to have OS/2 drivers by the time you read this.

With a maximum of 4MB of VRAM, the fully VESA-compatible 86C928 chip offers true-color support for resolutions up to 1,024-by-768.

Most of the 86C928-based boards—whether for the ISA or EISA bus—provided excellent performance in the 10-megapixel-per-second range on our 16-color tests. (The ELSA Winner 1000 and Number Nine boards did not provide Super VGA 16-color drivers, and the ELSA Winner 1000 also lacked 16-color drivers for 1,024-by-768 mode.)

The majority of these boards separate into two groups for 256-color results. At the high end of the two clusters are the ELSA Winner 1000, the Diamond Stealth Pro, and the Actix Graphics Engine Ultra. In its EISA mode at Super VGA resolution, the ELSA Winner 1000 took the lead with a score of 14.04 megapixels per second, followed by the ISA-based Diamond Stealth Pro with 13.64 megapixels per second. At 1,024-by-768 by 256 colors, the Diamond Stealth Pro and EISA-based ELSA Winner 1000 are pretty much on a par, with scores of 13.86 and 13.84 megapixels per second, respectively. Outside of the 86C928 class, only the Mach 32-based ATI Graphics Ultra Pro, EISA Version, provided significantly better Winbench scores on both 800-by-600 and 1,024-by-768 tests.

At the lower end of these two groups are the Artist Graphics WinSprint 900

HARDWARE

Graphics Adapters

► SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Diamond Stealth Pro	Diamond Stealth 24	Edge D24 BitBlaster Plus	ELSA Winner 1000	Focus 2 the Max TrueSpeed	Genoa WindowsVGA 24	
List price	\$349	\$249	\$99	\$548	\$199	\$179	
Graphics accelerator chip	S3 86C928	S3 86C801	Cirrus Logic GD5426	S3 86C928	S3 86C801	Cirrus Logic GD5426	
VGA BIOS manufacturer	Diamond	Diamond	Quadtel	ELSA	S3	Genoa	
VGA pass-through connector	Dual-pin	Dual-pin	Dual-pin	Dual-pin	Dual-pin	Dual-pin	
Hardware cursor	■	■	■	■	■	■	

Display Characteristics

Maximum graphics resolution:							
Noninterlaced	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,152 x 1,024	1,280 x 1,024	1,024 x 768	
Interlaced	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	
Maximum text resolution	132 x 43	132 x 43	132 x 43	132 x 43	132 x 43	132 x 43	
Maximum number of colors at each resolution:							
1,280 x 1,024 noninterlaced	16	16	N/A	256	16	N/A	
1,280 x 1,024 interlaced	16	16	16	N/A	16	16	
1,024 x 768	256	256	256	65,536	256	256	
800 x 600 (Super VGA)	65,536	65,536	65,536	16.7 million	65,536	65,536	
VESA support	BIOS	BIOS	BIOS	EEPROM	BIOS	BIOS	
Display memory (tested unit)	1MB 60-ns VRAM	1MB 60-ns DRAM	1MB 45-ns DRAM	1MB 80-ns VRAM	1MB 70-ns DRAM	1MB 70-ns DRAM	
Maximum installable memory	2MB VRAM	1MB DRAM	1MB DRAM	2MB VRAM	2MB DRAM	1MB DRAM	
RAMDAC	Diamond SS2410	Diamond SS2410	Integrated on accelerator chip	Sierra 15025CV	AT&T C491	Integrated on accelerator chip	
Virtual display	□	□	□	■	□	□	

Included Software Drivers

8514/A	□	□	□	□	□	□	
AutoCAD:							
Protected-mode ADI driver	■	■	■	■	■	■	
Display list processor	■	■	■	■	■	■	
Other CAD programs	■	■	■	■	■	■	
Lotus 1-2-3	■	■	■	■	■	■	
OS/2 Presentation Manager version	None	None	2.0	None	None	2.0	
Ventura Publisher (GEM)	□	□	■	■	□	■	
WordPerfect/Microsoft Word	■ □	■ □	■ □	□ □	□ ■	□ □	

Customer Support

Toll-free technical support	□	□	■	■	□	□	
Technical support hours (eastern time)	9:00–10:00 M–F, 11:00–7:00 Sat.	9:00–10:00 M–F, 11:00–7:00 Sat.	9:00–9:00 M–F, 10:00–7:00 Sat.	11:00–8:00 M–F	11:00–8:00 M–F	11:30–8:00 M–F	
BBS	■	■	■	■	■	■	
Warranty	5 years	5 years	1 year	5 years	2 years parts	2 years parts	

N/A—Not applicable. The product does not have this feature.
AMI—American Megatrends Inc. IIT—Integrated Information Technology

CONTINUES

Genoa WindowsVGA 24+	Hercules Graphite Card	Hercules Superstation XP610	Linwen/ Gaintec GXA	Metheus Premier 801
\$249	\$399	\$995	\$220	\$299
S3 86C801	IIT AGX-014	TI TMS34020	S3 86C924	S3 86C801
Quadtel	IIT	N/A	AMI	Quadtel
Dual-pin	Edge	Dual-pin	Dual-pin	Dual-pin
■	■	■	■	■

1,024 x 768	1,152 x 1,024	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024
1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024
132 x 43	132 x 60	N/A	132 x 43	132 x 43
N/A	N/A	16	16	16
16	16	16	16	16
256	256	256	256	256
65,536	65,536	32,768	256	65,536
BIOS	TSR (5.7K)	None	BIOS	BIOS
1MB 70-ns DRAM	1MB 80-ns VRAM	1MB 100-ns VRAM	1MB 80-ns VRAM	1MB 60-ns DRAM
2MB DRAM	1MB VRAM	4MB VRAM	4MB VRAM	2MB DRAM
AT&T C491	Brooktree 481	TI TLC34476	Music 9C4870	AT&T C491
□	□	■	□	□

□	□	□	□	□
■	■	■	■	■
■	■	■	■	■
■	□	□	■	■
■	□	□	■	■
2.0	None	None	None	None
□	□	□	□	■
■ ■	□ □	□ □	□ □	□ □

□	□	□	□	■
11:30-8:00 M-F	10:00-8:00 M-F	10:00-8:00 M-F	11:00-7:00 M-F	10:00-8:00 M-F
■	■	■	□	■
2 years	2 years	2 years	1 year	2 years

Lite and the Metheus Premier 928-4M, with respective scores of 9.90 and 9.57 at Super VGA resolution, and 9.95 and 9.70 in 1,024-by-768 mode. Even though these scores were low for this class of chip, they are still respectably mid-range when you consider them in comparison with the entire group of boards reviewed here.

HIGH SCORES, BUT...

The highest Winmark score of all boards tested—both ISA and EISA—was recorded by the ISA-based Number Nine #9GXE: 25.74 megapixels per second in 256-color 800-by-600 mode, and 28.17 and 26.56 in 16- and 256-color 1,024-by-768 modes, respectively. The high scores on our benchmark tests appear admirable, but the way the vendor achieved them is questionable.

We discovered that the #9GXE's drivers are optimized for our Windows benchmark tests in a manner that doesn't necessarily provide a corresponding level of performance in real-world applications. We found that the drivers are caching text strings—this can add up to impressive performance on our benchmark tests: Text-string caching takes advantage of the fact that our benchmark tests display the same string of text over and over again. But the technique isn't a realistic approach to real-world situations.

Running the board on an internal applications test suite, we saw the same performance results whether the caching was turned on or off; this is evidence that the text-string caching is there only to provide a performance boost on our benchmark tests. Number Nine could offer no example of real-world performance benefits that could be generated by text caching, and indeed argues that *PC Magazine's* decision to condone bitmap caching (which the Number Nine board now also supports) has opened the door for vendors to optimize for our benchmark tests as they like. Although this is otherwise a fine board (it sells for a competitive street price, supports up to 256 colors in 1,280-by-1,024 mode, and offers drivers to create a virtual desktop of 2K by 2K), the vendor's stratagem makes the benchmark test scores somewhat less than valid.

As a group, these 86C928 boards have a great deal to recommend them, but they

HARDWARE

Graphics Adapters

► SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Metheus Premier 928-4M	MicroStep AGC-2075e	Mirage Storm 1280/256	National Design Volante AT800	Nth S3 Advantage
List price	\$929	\$895	\$295	\$795	\$595
Graphics accelerator chip	S3 86C928	TI TMS34020	S3 86C801	TI TMS34020	S3 86C801
VGA BIOS manufacturer	Metheus/Quadtel	N/A	AMI/Mirage	N/A	Quadtel
VGA pass-through connector	Dual-pin	None	Dual-pin	Dual-pin	Dual-pin
Hardware cursor	■	□	■	□	■

Display Characteristics

Maximum graphics resolution:					
Noninterlaced	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,024 x 768
Interlaced	1,600 x 1,200	N/A	1,280 x 1,024	1,024 x 768	1,280 x 1,024
Maximum text resolution	132 x 60	132 x 48	132 x 43	132 x 43	132 x 43
Maximum number of colors at each resolution:					
1,280 x 1,024 noninterlaced	65,536	256	256	N/A	N/A
1,280 x 1,024 interlaced	65,536	N/A	256	N/A	16
1,024 x 768	16.7 million	256	65,536	256	256
800 x 600 (Super VGA)	16.7 million	256	65,536	256	65,536
VESA support	BIOS	None	BIOS	None	BIOS
Display memory (tested unit)	4MB 70-ns VRAM	2MB 100-ns VRAM	2MB 60-ns DRAM	1MB 100-ns VRAM	1MB 60-ns DRAM
Maximum installable memory	4MB VRAM	2MB VRAM, 4MB DRAM	2MB DRAM	1MB VRAM	1MB DRAM
RAMDAC	Brooktree 485	TI TLC34075	AT&T C491	Brooktree 478	AT&T C491
Virtual display	□	■	□	□	□

Included Software Drivers

8514/A	□	□	□	□	□
AutoCAD:					
Protected-mode ADI driver	■	■	■	■	■
Display list processor	■	■	■	■	■
Other CAD programs	■	□	■	□	■
Lotus 1-2-3	■	□	■	■	□
OS/2 Presentation Manager version	None	None	2.0	None	None
Ventura Publisher (GEM)	■	□	■	■	□
WordPerfect/Microsoft Word	□ ■	□ □	■ □	□ □	□ □

Customer Support

Toll-free technical support	■	□	□	□	■
Technical support hours (eastern time)	9:30-7:30 M-F	10:00-10:00 M-F	11:00-8:00 M-F	9:00-6:00 M-F	9:00-7:00 M-F
BBS	■	■	■	■	■
Warranty	2 years	2 years	5 years	Lifetime	1 year

N/A—Not applicable. The product does not have this feature.

AMI—American Megatrends Inc.; IIT—Integrated Information Technology.

ENDS

PC EDITOR'S CHOICE				
Number Nine #9GXE	Orchid Fahrenheit VA	PCG Photon 70/70 Deluxe	SixGraph Wizard 924	Video Seven WIN.PRO
\$895	\$299	\$495	\$295	\$249
S3 86C928	S3 86C801	S3 86C924	S3 86C924	S3 86C801
Number Nine/ Phoenix/Quadtel	Orchid	PCG	AMI/SixGraph	Quadtel
None	None	Dual-pin	Dual-pin	Dual-pin
■	■	■	□	■

1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
N/A	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
132 x 43	132 x 43	60 x 132	132 x 43	132 x 43
256	N/A	16	16	16
N/A	16	16	16	16
65,536	256	256	256	256
16.7 million	65,536	32,768	256	16.7 million
In driver	BIOS	BIOS	EPROM	BIOS
2MB 70-ns VRAM, 1MB 70-ns DRAM	1MB 60-ns DRAM	1MB 100-ns VRAM	1MB 80-ns VRAM	1MB 60-ns DRAM
2MB VRAM, 1MB DRAM	1MB DRAM	1MB VRAM	1MB VRAM	2MB DRAM
Brooktree 485	AT&T491	Sierra 11487CN	AT&T491	AT&T491
■	■	□	□	□

□	□	□	□	□
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
None	1.3, 2.0	None	None	□
□	□	■	□	■
■ ■	■ □	□ □	■ ■	■ ■

■	□	□	■	■
9:00-5:00 M-F	10:00-10:00 M-F	12:30-8:00 M-F	9:00-5:00 M-F	11:00-8:00 M-F
■	■	■	■	■
5 years	4 years	5 years on parts, 1 year on labor	5 years	7 years

aren't always the most economical solution for users who need a board that can comfortably spend much of its time in the DOS world as well as in the Windows world. For that capability, you may be better off with a lower-priced, 86C801 solution; these typically sell in the \$250 range and provide similar or slightly better DOS video performance than their higher-end siblings.

For example, the 86C928-based boards' DOS video performance ranged

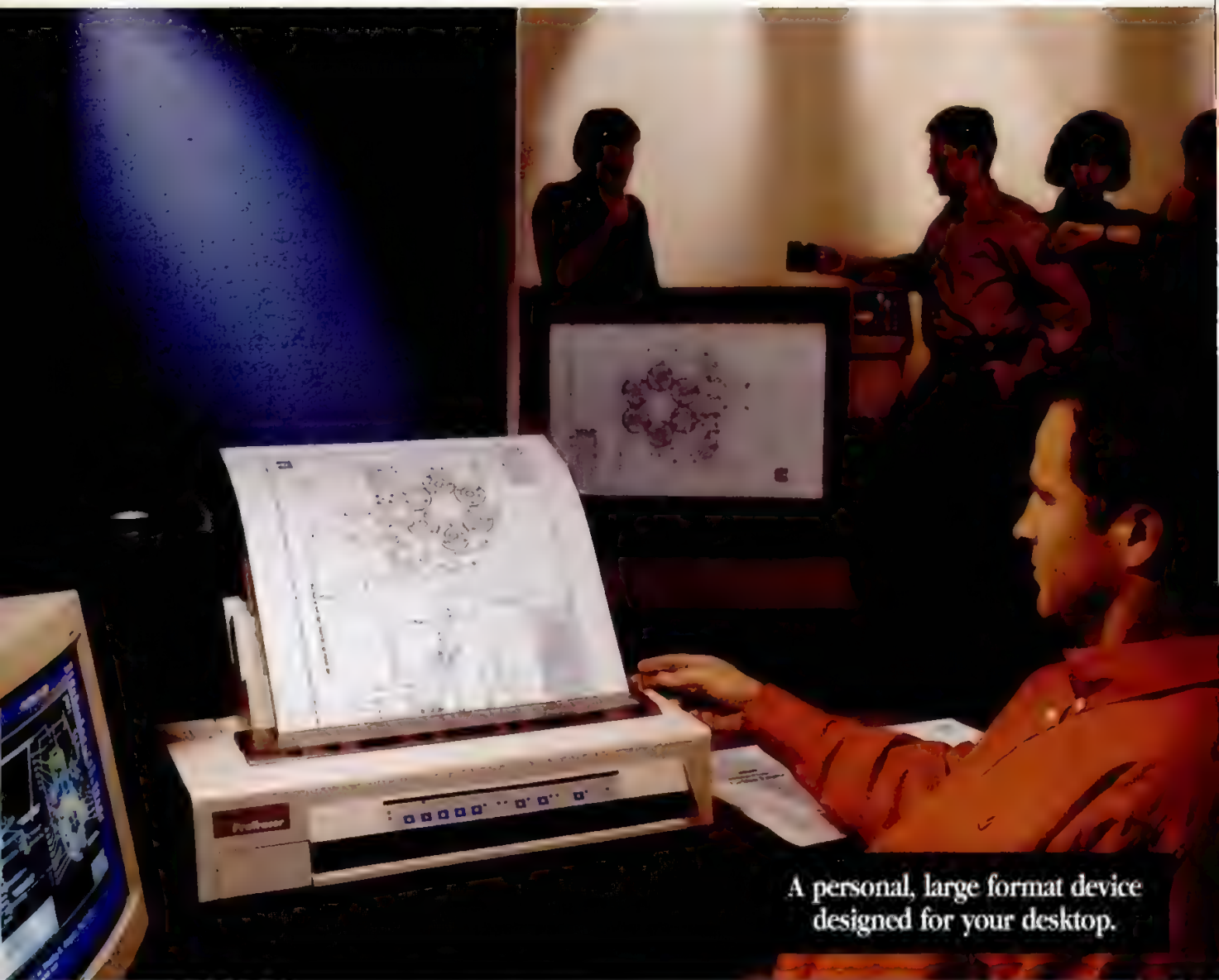
AutoCAD performance varies widely with the boards based on the 86C928, a fact that can be ascribed to the different drivers used.

from a high of 4.16 million operations per second, scored by the Actix GraphicsEngine Ultra, to the Diamond Stealth Pro's 3.09 score. Among 86C801 machines, scores ranged from a high of 4.30 to a low of 3.59. And most of the 86C801-based boards' Windows' performances are on a par with the 86C928 products in 16-color mode, although they generally lag behind in 256-color mode. The 86C928-based boards are a better solution for full-time Windows users with a little more money to spend for a VRAM-based solution.

LIVING IN THE CAD WORLD

AutoCAD performance varies widely with the 86C928-based boards, a fact that can be ascribed to the different drivers used. Artist Graphics, ELSA America, and Metheus each write their own AutoCAD drivers and display list processor drivers. The Diamond Stealth Pro uses AutoCAD drivers from Panacea; the Actix GraphicsEngine Ultra is the only board in this group to use the drivers supplied by S3. Number Nine's AutoCAD drivers are forthcoming and should be available by the time you read this. Both the EISA-bus ELSA Winner 1000 and the Diamond Stealth Pro suffered minor screen artifacts during AutoCAD testing.

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HARDWARE

Graphics Adapters

The Artist Graphics WinSprint 900 Lite proved itself a winner with a total AutoCAD time of 53.11 seconds, the fastest score of all boards in this review. That's not surprising, considering the company's long history in the CAD/CAM market. Artist Graphics' AutoCAD Display List Processor includes several custom features, including AutoCAD Extension for Windows acceleration. The board also comes with a Windows Command Center utility that lets you pop up a 2-by-2-matrix icon menu in any Windows application, and a Panoramic View utility that lets you scroll through a 2,048-by-768 window. It also remembers the block at which you left off when you exit any Windows application.

Although the WinSprint 900 Lite's Winmark scores are not the best of this bunch, the overall quality and, particularly, the company's AutoCAD driver make this an attractive choice. Sold on the street for around \$400, the board installs easily; the pins on the back are trimmed smoothly, an uncommon but appreciated bit of quality control. The product supports a minimum 72-Hz refresh rate in all modes except 1,280-by-1,024, which supports only 60 Hz.

The Actix GraphicsEngine Ultra is one of the best deals in the 86C928 group, combining excellent performance under Windows with the lowest price of the bunch. Available for around \$285 on the street, the Actix GraphicsEngine Ultra installs easily enough in a 16-bit slot. As is too common, however, the pins on the back of the board are a bit long. The Diamond Stealth Pro comes close to the Actix GraphicsEngine Ultra in price (around \$250 on the street) and Windows performance, and like it, the pins on the back of the board were a bit long. Overall design is sturdy, though, and installation is easy.

If money is not a major consideration and if you simply must have an 86C928-based board that supports 4MB of VRAM, you should investigate the \$929 Metheus Premier 928-4M, available on the street for around \$640. The additional memory (Metheus is the only manufacturer reviewed here to offer an 86C928-based board with this much RAM) gets you up to a noninterlaced resolution of 1,600-by-1,200; in this mode, you can display up to 256 colors. If money is a major

concern, you can buy the board for \$399 with 1MB of VRAM or \$549 with 2MB, but you'll lose the high-resolution capabilities. Remember, though, that despite these advantages, the board was slower than many of its siblings on our 256-color Winbench tests.

A unique feature of the Metheus board (in any of its versions) is its ability to work in conjunction with another Me-

theus Premier 928-4M board in a "dual-head" mode. This means you can run separate applications in full-screen mode on two displays or have a single application span two screens. Unlike the \$995 924-based Colorgraphics Twin Turbo Accelerator, which comes with all the works for two monitors on one card, the Metheus board spares you from having to pay extra for the ability to run two moni-

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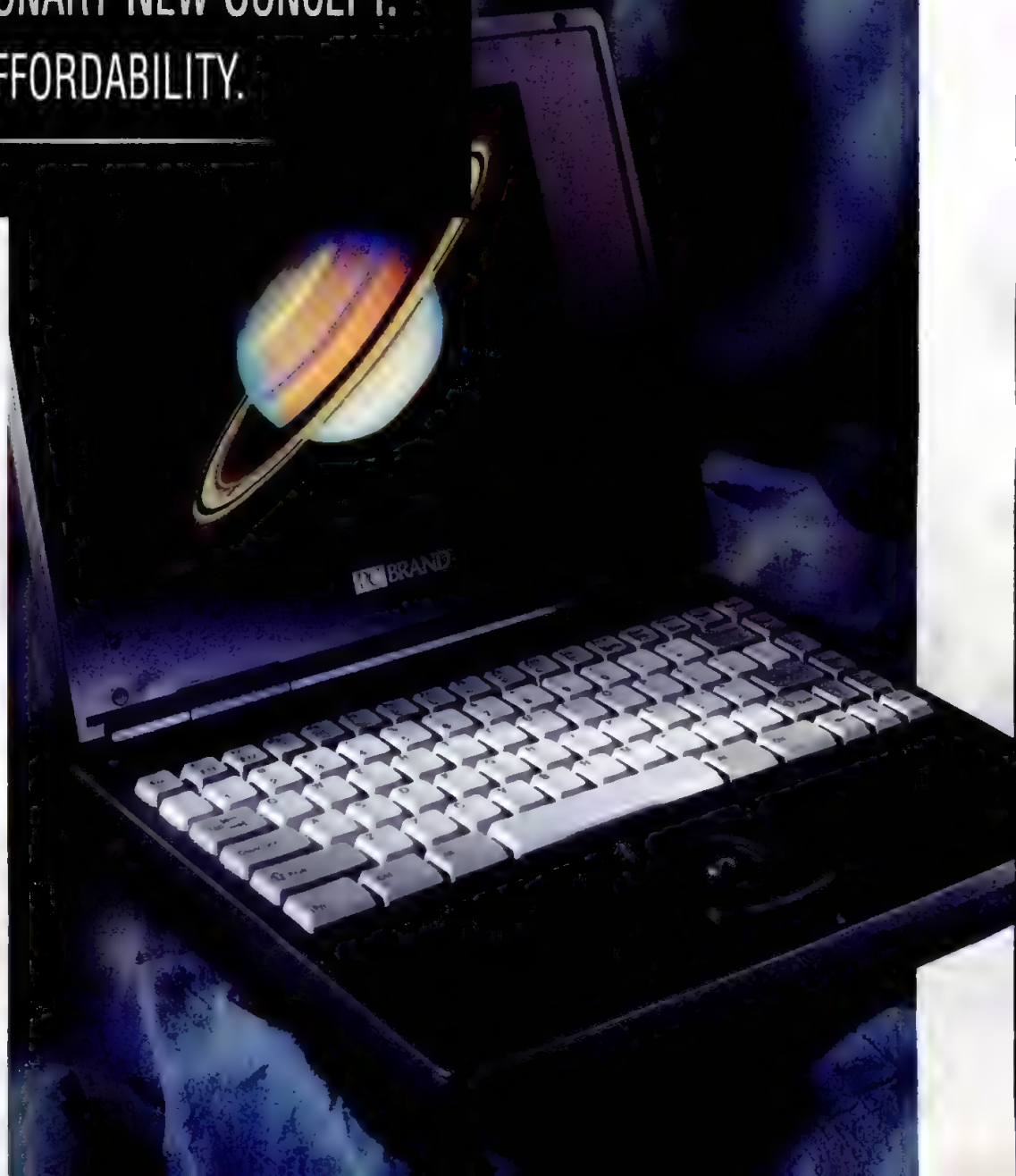


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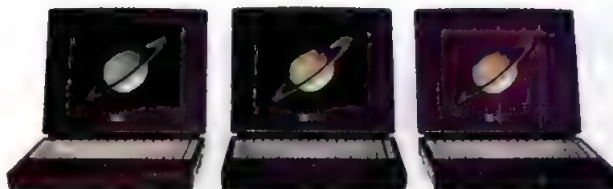
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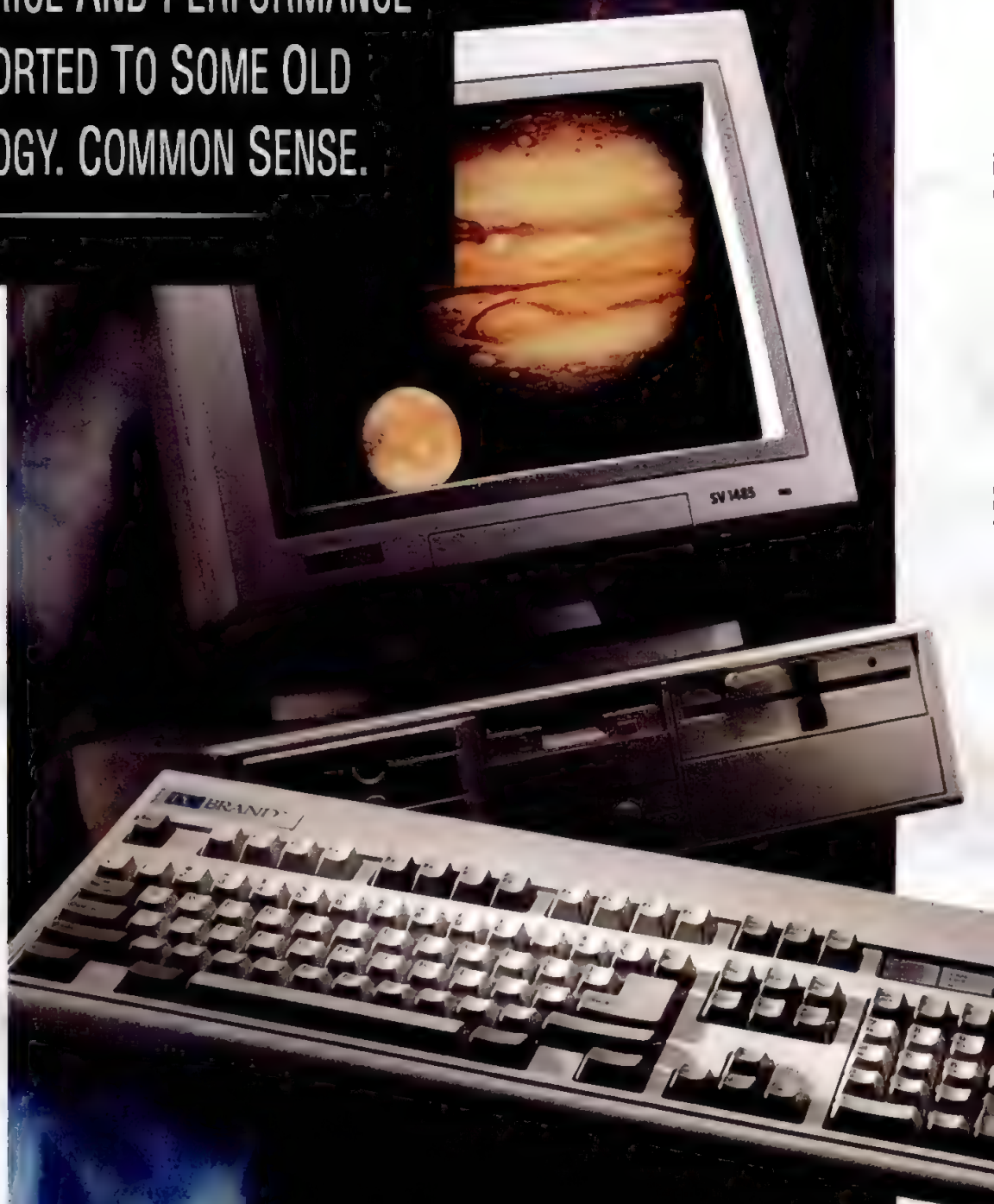
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Processor	386/SX-33	486/SLC-33	486/SX-25	486/DLC-40	486/DX-33	486/DX2-50	486/DX2-66
Memory	2MB	4MB	4MB	4MB	4MB	4MB	4MB
Hard Drive	105MB	105MB	105MB	170MB	170MB	170MB	170MB
1.44MB FDD	•	•	•	•	•	•	•
1.2MB FDD	•	•	•	•	•	•	•
16-bit SVGA	512KB	512KB	1MB	1MB	1MB	1MB	1MB
Color SVGA	.39 dot pitch	.28 dot pitch	.28 dot pitch	.28 dot pitch	.28 dot pitch	.28 dot pitch	.28 dot pitch
Monitor (1024 x 768)							
2 Serial / 1 Parallel Ports	•	•	•	•	•	•	•
Upgradable Processor	•	•	•	•	•	•	•
200W Power Supply	•	•	•	•	•	•	•
101-Key Keyboard	•	•	•	•	•	•	•
Serial Mouse	•	•	•	•	•	•	•
MS-DOS & Windows	•	•	•	•	•	•	•
CompuServe	•	•	•	•	•	•	•
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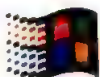
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CIRCLE 055 ON READER SERVICE CARD

Graphics Adapters

tors if you don't intend to use it.

The dual-identity ELSA Winner 1000, which is sold direct at its \$548 price, is easy to install in either its EISA or ISA configuration. The board's backplate disconnects easily and slides onto the opposite end so that you can install the board

in the desired bus. Although an interesting design feat, the split-personality ELSA Winner 1000 is of limited use unless you want to stock a single unit for your company's ISA and EISA systems or you're contemplating a future upgrade from an ISA to an EISA model.

FIRST OF THE IIT WAVE

• Hercules Graphite Card

BY JAMES KARNEY

At test time, the Hercules Graphite Card was the only board shipping based on the IIT AGX-014, one of two new graphics accelerators from Integrated Information Technology. Until now, IIT has been best known for its line of math coprocessors. The IIT AGX-014 is a 16-bit graphics accelerator that is based on an XGA (Extended Graphics Array) core and optimized for Windows. IIT says it has also built in Super VGA support for programs that require CGA, EGA, VGA, or Hercules compatibility. (The IIT AGX-015 is a 32-bit version tuned for VL-Bus designs. VidTech Microsystems plans to ship an AGX-015-based VL-Bus card later this

year.) IIT claims that its engine can handle 4 operands per instruction, compared with two for 8514-based accelerators. The chip can provide resolutions of up to 1,280-by-1,024 with 16 colors (1MB VRAM), 1,280-by-960 with 256 colors (2MB VRAM), and 1,280-by-960 with 16.7 million colors (6MB VRAM). Accelerated functions include BitBlt, clipping, color dither, line draws, masking, object shading, pattern fills, and surface mapping.

The \$399 card—about \$300 on the street—offers 1MB of VRAM and a maximum resolution of 1,280-by-1,024 with 16 colors. Other capabilities are 1,024-by-768 with 256 colors, 800-by-600 with

66,560 colors, and 640-by-480 with up to 16.7 million colors. The card supports up to a 90-Hz vertical refresh rate in Super VGA mode, and up to 80 Hz in noninterlaced 1,024-by-768 mode, but doesn't report a VESA BIOS in VESA-compliance testing. It supports the VESA refresh-rate standards via a TSR.

AutoCAD drivers were not available for testing the Graphite in that environment. Results on our DOS video test indicate that if you use DOS applications as much as you do Windows programs, then steer clear, because the Graphite's DOS video score was among the lowest.

A careful examination of the polylines test in our Winbench suite showed very high scores for all but the random lines entry, which accounts for about two percent of the other values.

A check with Hercules Computer Technology brought the admission that we had received a driver that bypasses both the polylines test and—by not drawing the overlapped portion—a part of the BitBlt raster operations test in which 64-by-64-bit raster images are blitted on to the screen and overlap each other. The company told us that this driver was part of an internal experiment and that it should not have been released (IIT later confirmed that it had worked with Hercules on this internal experiment). Hercules then sent a second driver that it told us did not specifi-

IIT claims its engine can handle 4 operands per instruction, while 8514-based accelerators can handle only two operands per instruction.

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HARDWARE

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cally look for our benchmarks, but in fact we noticed few changes from the earlier version. Hercules had amended the overlapping BitBlts problem so that the product no longer avoided drawing the overlapped portion of the 64- by 64-bit raster images. We then also discovered, however, that the driver incorporates the same text string that Winbench 3.1 uses in its text test. The results of 14.60 and 14.00 in 256-color Super VGA

and 1,024-by-768 modes, respectively, were achieved with this second set of drivers.

Even though these scores are among the highest that we saw for the ISA-based boards, the fact that Hercules achieves them with drivers that are optimized solely for benchmark test performance puts them in a poor light. So, it is impossible for us to consider the board's results to be valid.

EISA-based board that came the closest to the ATI's performance was ELSA Winner 1000; this S3 86C928-based product managed a score of 14.04 in Super VGA mode with 256 colors, and a score of 13.84 in 1,024-by-768.

The ATI's high Graphics Winmark scores were due to its bitmap cache, which stored bitmaps in available VRAM, where they can be retrieved more quickly than from system memory. This feature will only provide a performance benefit in applications when the images being transferred are small enough to fit into the available VRAM. *PC Magazine* ran an internal-applications suite to determine the effect bitmap caching might have on real-world performance, and we did see a small increase with bitmap caching activated that was not there with the caching turned off.

The ATI board also distinguished itself with one of the lowest total times on our AutoCAD tests: 54.15 seconds. Additionally, the new ATI AutoCAD display-list processor driver from Vibrant Graphics for the Ultra Pro did not have

PROPRIETARY SOLUTIONS

EDITORS' CHOICE

ATI Graphics Ultra Pro, EISA Version

• **Compaq QVision 1024/E**

BY STEPHEN W. PLAIN

ATI Technologies and Compaq Computer Corp. both provided EISA-based accelerator boards that sported their own chips: the \$899 ATI Graphics Ultra Pro, EISA Version (an Editors' Choice), and the \$375 Compaq QVision 1024/E.

The EISA-based ATI was one of the fastest boards of the EISA and ISA products in this roundup. Based on the ATI Mach 32 chip, it turned in top Graphics Winmark scores at all resolutions, managing 15.34 megapixels per second in 800-by-600 with 16 and 256 colors and was just slightly slower in 1,024-by-768. The

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HARDWARE

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the information update problems we experienced in our last roundup, when we tested the ISA version of this board.

On our DOS-based video test, the EISA-version Ultra Pro's score of 4.36 million operations per second exceeded that of the 86C924-based Advanced Integration Research Aview 2E EISA card and the 86C928-based ELSA Winner 1000, but the Ultra Pro lagged slightly behind the Compaq QVision 1024/E.

The ATI board's high performance comes with a correspondingly high price tag, however; the EISA version lists for \$899 with 2MB of VRAM, making it one of the most expensive of the bunch. On the street, it sells for about \$500.

ATI Technologies remains on the cutting edge of the graphics board market with its Ultra line. The Ultra Pro handles 2MB of 80-ns VRAM, making it capable of 256 colors at 1,280-by-1,024 noninterlaced resolution with a vertical refresh rate as high as 74 Hz. In VGA and Super VGA resolutions, it handles 16.7 million colors.

One of ATI's trademarks has always been the flexibility of its products in working with a wide range of monitors, and the Ultra Pro is no exception. This board can be set to eye-saving refresh rates above 70 Hz for all modes, or, through an extremely flexible setup utility, it can be made to work with almost any fixed-frequency monitor.

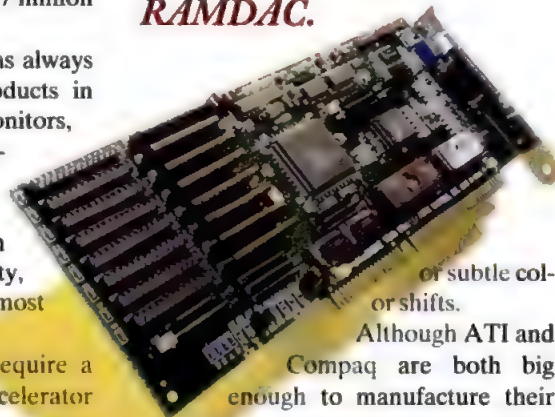
Unlike many boards that require a boot-up program to set the accelerator board into the desired mode, the Ultra Pro stores the desired power-up configuration directly into the board's EEPROM when you run the setup utility. ATI ships a fairly extensive diagnostic utility with the Ultra Pro that enables you to test everything from color depths to the EEPROM and RAMDAC. Unlike previously reviewed ATI cards, the EISA version of the Ultra Pro used a Texas Instruments RAMDAC; the company explained that it uses several RAMDACs it considers functionally equivalent. The Ultra Pro comes with drivers for Microsoft Windows, Lotus 1-2-3, OS/2, GEM, WordPerfect, and several other popular applications.

You should know that ATI has been one of the most prolific vendors when it

comes to driver updates. While constantly updating drivers does not always work for the benefit of the user, we found the driver-set received for the tested unit to be remarkably stable.

ATI's Crystal Fonts provide truly impressive-looking fonts under Windows at 1,024-by-768 and 1,280-by-1,024 resolutions through anti-aliasing. These highly readable fonts are made possible by outlining each character with shades of gray

*ATI ships a fairly
extensive diagnostic utility
with the Ultra Pro that
enables you to test every-
thing from color depths to
the EEPROM and
RAMDAC.*



of subtle color shifts.

Although ATI and Compaq are both big enough to manufacture their own accelerators for their graphics boards, the two companies are a study in contrast in terms of design philosophy. ATI is in the business of supplying graphics adapters for machine-independent use; it must keep a keen eye on compatibility issues and has done so very effectively. But Compaq is accustomed to being the system manufacturer that third-party manufacturers must work with, and this shows in some of the company's choices.

For example, Compaq supports the VESA-standard vertical refresh rate of 72 Hz at 800-by-600, but at an unconventional 53.77-kHz horizontal refresh rate. VESA specifies a 48.01-kHz horizontal refresh rate in that mode. The 53.77-kHz rate is supported by Compaq's line of

QVision monitors, and it shouldn't be a problem for most variable-frequency multiscanning monitors. But we were unable to make the QVision board sync properly in 800-by-600 mode with the fixed frequency multiscanning monitor shipped with a Gateway 2000 computer, and this could be troublesome for some other fixed-frequency designs as well.

The QVision 1024/E comes with 1MB of 80-ns VRAM installed and offers resolutions up to 1,024-by-768. The Compaq uses a BrookTree RAMDAC and provides a hardware cursor and a palette of 16.7 million colors, all of which are available simultaneously in 640-by-480 mode. The QVision 1024/E ships with drivers for the following: Windows 3.1, AutoCAD, and OS/2 1.21.

Matched against the other EISA-based boards, the QVision 1024/E performed at the low end on our 256-color Windows tests. In 16-color mode, it did better, but was still no match for the performance-leading Ultra Pro. The Compaq accelerator caches bitmaps and speeds line draws, but it lacks other acceleration techniques such as clipping and polygon fills.

Informal testing of the ISA version of the board, the \$375 QVision 1024/I, produced results comparable to that of the EISA version. In our issue of January 12, 1993, we reported that the QVision 1024/I provided 2.34 megapixels per second under Super VGA with 256 colors when we tested it on a 386/25 system; on a 486/25 unit with the latest drivers, the same board achieved 7.24 megapixels per second for this story.

The QVision 1024/E's 83.67-second AutoCAD total time was the slowest of the EISA-based group, and bettered only a few products in the ISA class: the S3 86C801-based Mirage Storm 1280/256, the 86C924-based PCG Photon 70/70 Deluxe, and the four cards using the Cirrus Logic GD5426 chip.

If you do have a variable-frequency multiscanning monitor (or a Compaq QVision monitor), the QVision 1024/E is a reasonable choice at \$375 (about \$299 on the street), providing the traditional quality of a Compaq product and a generous three-year warranty. The documentation and setup utility provided are explicit and intuitive.

26 PEOPLE 6 PLATFORMS 1 SIMPLE SOLUTION



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AT THE REAR: THE S3 86C924

- Advanced Integration Research Aview 2
- Advanced Integration Research Aview 2E
- Colorgraphic Twin Turbo Accelerator
- Linwen/Gaintec GXA
- PCG Photon 70/70 Deluxe
- SixGraph Wizard 924

BY BRUCE BROWN

The S3 86C924 chip, which is the pin- and register-compatible update to S3's original 86C911 accelerator, began appearing on boards only in the third quarter of 1992, yet already it trails the field of the reviewed products in both Microsoft Windows and DOS testing. AutoCAD performance results for the tested 86C924-based boards were more in line with the rest of the group's, partly as a result of the display-list processor drivers the vendors used.

The 86C924 adds support for 24-bit RAMDACs in VGA mode. With a 16-bit internal data path and 16-bit data path to memory, the 86C924 chip supports 512K to 1MB of VRAM, along with a maximum resolution of 1,024-by-768 with 256 colors and 1,280-by-1,024 with 16 colors.

The 86C924-based boards we tested were the \$250 Advanced Integration Research Aview 2 and the \$300 Advanced Integration Research Aview 2E, the \$995 Colorgraphic Twin Turbo Accelerator, the \$220 Linwen/Gaintec

GXA, the \$495 PCG Photon 70/70 Deluxe, and the \$295 SixGraph Wizard 924. All are ISA-based boards, except for the EISA-based Aview 2E. All but one use 80-nanosecond VRAM; the PCG uses 100-ns VRAM. Only the Colorgraphic product currently ships with OS/2 drivers (its own); the other companies participating in this review expect to have OS/2 drivers available by the time you read this.

On our Graphics Winmark tests, the 86C924- and ISA-based boards scored from 7.01 to 7.08 megapixels per second in 16 colors at Super VGA and from 6.86 to 7.22 in 1,024-by-768 modes. (The Colorgraphic did not come with 16-color drivers for either resolution.) The EISA-based Aview 2E managed 7.16 megapixels per second in both modes. The 16-color scores of these boards could best only those achieved by products using the Cirrus Logic GD5426 chip and the Weitek W5286 chip.

With 256 colors at these modes, the ISA, 86C924-based boards came in from a low of 5.22 megapixels per second (the

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Graphics Adapters

Colorgraphic) to a high of 5.81 megapixels per second in Super VGA mode (the Linwen/Gaintec), and from 5.19 (again, the Colorgraphic) to 5.72 (the Aview 2) in 1,024-by-768. The EISA-based Aview 2E pushed the bar a bit higher at 256 colors, achieving 6.74 and 6.46 megapixels per second at Super VGA and 1,024-by-768 resolutions, respectively. As a class, however, in 256-color modes the 86C924 group manages to keep ahead of only the Weitek W5286-based ASL Lightning SVGA, from Alpha Systems Labs.

In terms of their DOS-based video performance, the boards' scores scraped the bottom layer, generally ranging from just under 1.7 million to about 2 million operations per second. The Colorgraphic's score of only 1.08 million operations per second was both the lowest score of this class and the lowest score of all the boards we tested.

Low-end scores (and lack of AutoCAD drivers) aside, the Colorgraphic does have a unique feature: A single board holds two video chips, two banks of VRAM (1MB each), two RAMDACs, and two 15-pin output ports. Its Windows drivers let you drive two attached monitors and have a single application bridge the two screens; If you move the cursor beyond the edge of the first screen, it appears on the other screen. With this setup you can display twice as many columns in a spreadsheet, or an extremely wide word processing document. You can even have full-screen windows of two applications.

You can install up to four Colorgraphic boards in one PC and run as many as eight monitors simultaneously. But unless you need two monitors run from one slot, the Colorgraphic's high price (\$995, sold direct) and relatively slow performance make other boards more desirable. Running two monitors simultaneously does serve to slow operations, to 3.25 and 3.33 megapixels per second on our 256-color 800-by-600 and 1,024-by-768 Windows benchmark tests, respectively.

In terms of AutoCAD testing, the 86C924-based boards' total test times ranged from a sixth-place score of 66.94 seconds (which was produced by the SixGraph Wizard 924 board) to a slower, 88.15 seconds (which was turned in by the

PCG Photon 70/70 Deluxe product).

The SixGraph, which out-performed all but one of the more expensive 86C928-based boards in terms of AutoCAD total times, uses the standard S3 Display List Processor (written by ATC Graphics). The PCG, despite its slower AutoCAD score, comes with the Soft Engine display-list processor driver that incorporates features such as a magnifying

window with real-time zooming, a birds' eye view, programmable pop-up icon menus, anti-aliasing, and enhanced display-list erasing. The SixGraph is sold on the street for \$250; the PCG is available for \$350 to \$400.

TRUE COLORS, FOR SOME

Although the 86C924 chip can support 24-bit color, not all of the tested boards

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COMPUTERS WITHOUT COMPROMISE

had 24-bit RAMDACs. Boards equipped with an AT&T 20C491 24-bit RAMDAC were the ISA-bus Aview 2 and EISA-bus Aview 2E (identical except for the I/O bus) and the SixGraph. The Linwen/Gaintec uses a 16-bit Music RAMDAC, and Personal Computer Graphics plans to replace the 16-bit RAMDAC on its board with a 24-bit AT&T 20C491 by April 1993 without increasing the \$495 price. Colorgraphic's two 16-bit Brooktree RAMDACs will also be replaced soon with 24-bit units from AT&T.

All of the boards reviewed in this section had long, untrimmed pins that could scratch if you reach behind the board; additionally, the SixGraph Wizard 924 suffered from a loose back plate. On the Aview 2E, the video mode could not be changed via the Windows Setup icon, though it worked fine running Windows Setup from the DOS prompt—an acceptable but somewhat inconvenient operation.

The performance of the 86C924-based boards certainly places limits on their appeal. The \$220 Linwen/Gaintec (only marginally discounted on the street) is the least expensive S3 86C924-based adapter tested and one of the better performers in this category, but it faces tough competition from cheaper S3 86C801-based boards such as the \$199 Focus 2 the Max TrueSpeed and the 80-MHz \$199 Actix Graphics Engine 32 Plus.

Both of the boards from Advanced Integration Research are fairly low priced, with the Aview 2E leading the way as the lowest-priced EISA product of all the boards reviewed here. (You can expect to find the Aview 2 selling for around \$170 to \$200 on the street, and the Aview 2E for \$220 to \$260.) But again, if you're looking for an EISA board that has a better price/performance ratio, a mere \$30 to \$80 more on the street will buy you increased Windows and DOS performance in the shape of the Compaq QVision/E.

A MOVE UP BUT A STEP BEHIND

- Boca SuperX Accelerator VGA
- Cardinal VideoSpectrumXL
- Edge D24 BitBlaster Plus
- Genoa WindowsVGA 24

BY JOSEPH DESPOSITO

Cirrus Logic, well-known for its Cirrus Logic GD5422 dumb frame buffer chip used in boards such as Sigma Designs' \$429 WinStorm, Aamazing Technologies' \$179 Aamazing VGA 1000, and STB Systems' \$179 Evolution VGA, enters the video acceleration market with the Cirrus Logic GD5426. But the GD5426 sticks close by Cirrus Logic's frame buffer roots by performing best in DOS video modes.

The GD5426 doubles the Graphics Winmark performance of its nonaccelerated sibling at some resolutions and color depths (based on informal testing of the GD5422-based boards from Sigma and Aamazing). But the problem is that the GD5426 still lags behind when measured against the Windows performance of much of the accelerator competition.

SLOW GOING

The GD5426-based boards we tested managed only 4.04 to 4.14 megapixels per second in 16-color Super VGA and 4.41 to 4.60 in 16-color 1,024-by-768 mode tests, for example, while 86C801- and 86C928-based

(which scored around 12 to 14 megapixels per second).

All the GD5426 boards we saw used a 16-bit ISA host bus interface. According to Cirrus Logic, the chip itself delivers 32-bit access to display memory and also has a 32-bit internal data path for Extended Industry Standard Architecture (EISA) or local-bus solutions. However, this did not seem to be enough to guarantee high performance for the boards based on it.

Part of the reason that the GD5426-based boards can't keep up is that the chip accelerates only BltBlts, image transfers, and raster operations. And while the company says that the chip provides for font caching, none of the boards we tested for this review supported that feature.

Four of the video accelerators tested here use the Cirrus Logic GD5426: Boca Research's \$295 Boca SuperX Accelerator VGA, Cardinal Technologies' \$249 VideoSpectrumXL, Edge Technology's \$99 Edge D24 BitBlaster Plus, and Genoa Systems' \$179 Genoa WindowsVGA 24.

The actual price spread among these products is not as great as it seems, however: The Boca SuperX Accelerator VGA sells on the street at around \$160 to \$180, and the Cardinal VideoSpectrumXL board sells for \$150 to \$179, while the Edge D24 BitBlaster Plus sells direct to end users for \$99. The Genoa board typically goes for about \$130 to \$140. All four boards are similar in design, and each board comes configured with 1MB of DRAM.

The GD5426 has an integrated Palette DAC that can be configured as an industry standard RAMDAC by the vendor. The Palette DAC on the GD5426 chip performs the same function as a RAMDAC, but the default configuration is 256-by-18-bit operation; most RAMDACs provide a 256-by-24-bit stor-

While Cirrus Logic says that its chip provides for font caching, none of the GD5426-based boards we tested supported that feature.

products racked up average scores of 10 megapixels per second in these modes. (Even the 86C924 chip outdid the GD5426: The boards using that chip scored around 7 megapixels per second.)

At 256 colors in Super VGA and 1,024-by-768 resolutions, the GD5426-based cards scored close to or a little better than 8 megapixels per second, but those scores still did not come close to those achieved by most of the 86C801-based or 86C928-based competition

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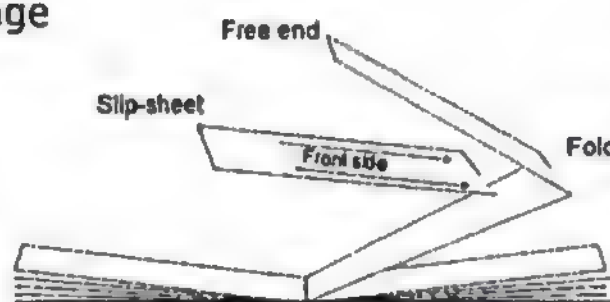
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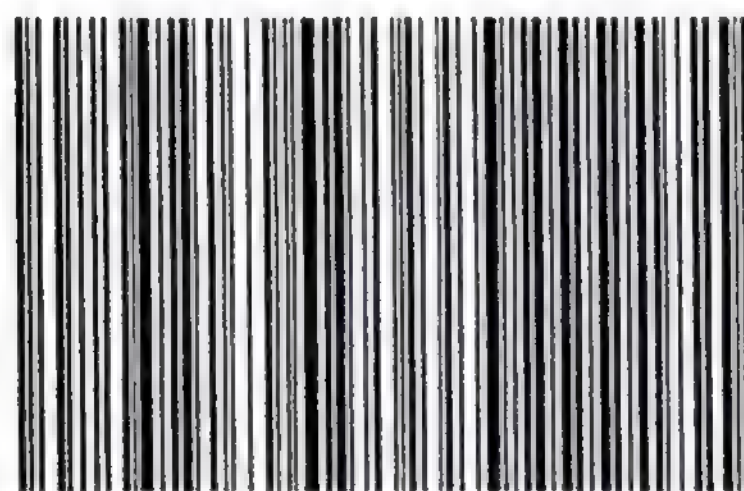
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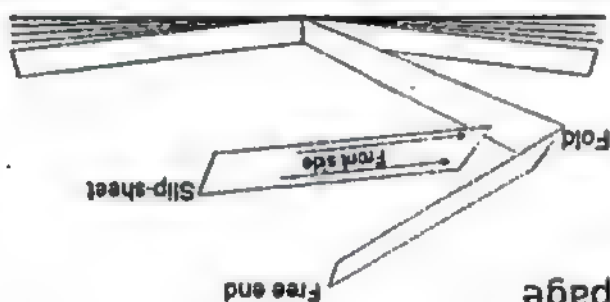


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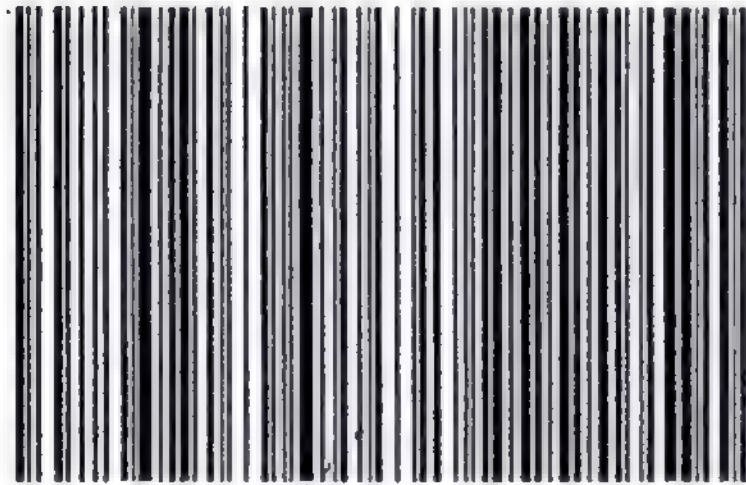
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age area for color lookup tables.

The GD5426 provides a maximum of 256 colors at 1,280-by-1,024 interlaced, 64K at 1,024-by-768 and in SVGA mode, and 16.7 million at VGA resolution. With only 1MB of DRAM (the configuration of the four boards we tested), the chip supports 16 colors at 1,280-by-1,024 interlaced and 256 colors at 1,024-by-768 mode.

The chip supports a maximum 72-Hz noninterlaced refresh rate at 800-by-600, and at 1,024-by-768. None of the boards included drivers that take advantage of the highest 1,280-by-1,024 interlaced 256-color mode. All of the boards came with Cirrus Logic's OS/2 drivers (this is one area where Cirrus Logic is ahead of S3, whose OS/2 drivers are just starting to ship).

HIGHS AND LOWS

The Genoa WindowsVGA 24 performed best of these four cards in Windows tests, with the Boca SuperX Accelerator VGA placing last overall. But the performance differences are more pronounced in some cases than in others. For example, the Winmark scores at 800-by-600 by 16 colors for the Genoa WindowsVGA 24 and the Boca SuperX Accelerator VGA are 4.14 and 4.09 megapixels per second, respectively. At 1,024-by-768 resolution with 256 colors, you'll see that the differences are more dramatic, with the Genoa board at 8.29 and the Boca board lagging back at 5.03 megapixels per second.

The 1,024-by-768, 256-color Winmark ratings for the Edge D24 BitBlaster Plus and Cardinal VideoSpectrumXL, at 7.82 and 7.52 megapixels per second, respectively, are closer to that achieved by the Genoa board.

The performance differences can be attributed in part to the display drivers: Boca, Edge, and Cardinal all use the Windows display drivers that are provided by Cirrus Logic, with little if any enhancement included, while Genoa writes its own drivers for the advanced Windows resolutions.

The same speed differences were evident in informal testing of some Windows applications. For example, in Microsoft Excel 4.0, scrolling cells from left to right is significantly slower with the Boca

Graphics Accelerators: Facts at a Glance

CONTINUES

Actix Systems Inc.

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Actix GraphicsEngine 32 Plus

List price: With 1MB DRAM, \$219.

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In short: One of the lowest-priced of the S3 86C801-based accelerators, the Actix GraphicsEngine 32 Plus delivers solid Windows performance and excellent DOS performance, but its FCC rating is only Class A.



Actix GraphicsEngine Ultra

List price: With 1MB VRAM, \$329.

CIRCLE 468 ON READER SERVICE CARD

In short: The \$329 Actix GraphicsEngine Ultra is one of the best S3 86C928-based boards of the group, combining excellent Windows performance with the lowest list price.

Advanced Integration Research Inc.

2188 Del Franco St., San Jose, CA 95131; 800-866-1945, 408-428-0800; fax, 408-428-0950

Advanced Integration Research Aview 2

List price: With 1MB VRAM, \$250.

CIRCLE 469 ON READER SERVICE CARD

In short: The Advanced Integration Research Aview 2 has a low price, and unlike some other boards in the S3 86C924 class, both it and the EISA version boast 24-bit RAMDACs. Although a decent board, it cannot compete with the price/performance aspect of S3 86C801 designs.

Advanced Integration Research Aview 2E

List price: With 1MB VRAM, \$300.

CIRCLE 470 ON READER SERVICE CARD

In short: The Advanced Integration Research Aview 2E is a fairly low-priced, moderate performer. But if you have an EISA-bus machine and can afford to spend some more money, consider the ATI or the Compaq EISA board, which were better performers on our tests.

Alpha Systems Labs Inc.

2361 McGaw, Irvine, CA 92714; 800-998-3883, 714-252-0117; fax, 714-252-0887

ASL Lightning SVGA

List price: With 1MB VRAM, \$199.

CIRCLE 471 ON READER SERVICE CARD

In short: The only board in this group to use the Weitek W5286 chip, the affordable ASL Lightning SVGA suffers from subpar performance and currently lacks drivers for 1,280-by-1,024 and AutoCAD.

Artist Graphics Inc.

2675 Patton Rd., St. Paul, MN 55113; 800-627-8478, 612-631-7800; fax, 612-631-8424

Artist Graphics WinSprint 900 Lite

List price: With 1MB VRAM, \$495; with high-refresh 1,280-by-1,024 RAMDAC, \$795; with 2MB VRAM and high-refresh 1,280-by-1,024 RAMDAC, \$895

CIRCLE 472 ON READER SERVICE CARD

In short: Although the Artist Graphics WinSprint 900 Lite's Graphics Winmark scores are not the best of this bunch, this S3 86C928-based board's quality and AutoCAD driver make it an attractive choice.

ATI Technologies Inc.

3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W3S2; 416-756-0718; fax, 416-756-0720

ATI Graphics Ultra Pro, EISA Version

List price: With 2MB VRAM, \$899.

CIRCLE 473 ON READER SERVICE CARD

In short: The ATI Graphics Ultra Pro, EISA Version, is an excellent product, especially with a \$500 street price. Its appeal is in its high-powered performance and wide range of features, such as 2MB of VRAM, Crystal Fonts, and an EEPROM-based configuration.

Boca Research Inc.

6413 Congress Ave., Boca Raton, FL 33487-2841; 407-997-6227; fax, 407-997-0918

Boca Research SuperX Accelerator VGA

List price: With 1MB DRAM, \$295.

CIRCLE 474 ON READER SERVICE CARD

In short: Like the other boards based on the Cirrus Logic GD5426, this \$295 board delivered solid DOS performance but trailed in terms of Microsoft Windows and AutoCAD performance.

Cardinal Technologies Inc.

1827 Freedom Rd., Lancaster, PA 17601; 717-293-3000; fax, 717-293-3055

Cardinal VideoSpectrumXL

List price: With 1MB DRAM, \$249.

CIRCLE 475 ON READER SERVICE CARD

In short: The Cirrus Logic GD5426-based Cardinal VideoSpectrumXL turned in top scores under DOS (although it had some compatibility problems with our DOS video test).

Colorgraphic Communications Corp.

5388 New Peachtree Rd., Atlanta, GA 30341-2849; 404-455-3921; fax, 404-458-0616

Colorgraphic Twin Turbo Accelerator

List price: With 2MB VRAM, \$995.

CIRCLE 476 ON READER SERVICE CARD

In short: The \$995 Colorgraphic Twin Turbo Accelerator lets you drive two attached monitors and have a single application bridge the two screens—all from a single slot. But unless you need this ability, the board's relative slowness makes other products more desirable.

Compaq Computer Corp.

P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670

Compaq QVision 1024/E

List price: With 1MB VRAM, \$375.

CIRCLE 477 ON READER SERVICE CARD

In short: A relatively low-priced EISA board, the Compaq QVision 1024/E has quality workmanship and acceptable performance under both DOS and Microsoft Windows.

HARDWARE

Graphics Adapters

board than with the other three. In other Windows applications, however, the four boards were more evenly matched: For example, scrolling text in Microsoft Word for Windows 2.0 takes about the same time for all of the boards.

FASTEST DOS PERFORMANCE

The GD5426-based boards performed their best on the DOS VGA tests, turning in consistently solid results that ranged from 6,612 to 6,641 thousands of operations per second. These scores were almost a third again as fast as the scores of the other boards and even beat scores from GD5422-based dumb frame buffers. For users who also work extensively in DOS applications, these results are significant.

Of the foursome, Cardinal's VideoSpectrumXL was the only one to have trouble with some of the compatibility sections of the VGA Bench tests: in particular, the status register, scrolling, and split-screen tests. These problems suggest that the VideoSpectrumXL board may have some VGA compatibility problems, even though all of the applications attempted with the board ran successfully.

NOT FOR AUTOCAD

On our AutoCAD tests, the GD5426-based boards turned in lowly performance, with total times ranging from 142.96 to 146.43 seconds—almost double that of most of the rest of the roundup. All four boards lagged on the Text Zoom and 3-D Model Zoom tests. The only board in this roundup with a slower AutoCAD score than the GD5426-based boards was the 801-based Mirage Storm 1280/256, whose total time of 158.52 seconds was far behind the other 801-based boards.

Under AutoCAD, all the GD5426-based boards, with the exception of the Genoa WindowsVGA 24, use the Panacea display list processor. The Genoa WindowsVGA 24 board uses an AutoCAD display list processor driver from Graphics Software Labs. Along with this software, the Genoa board performed the AutoCAD tests a couple of seconds slower than the rest of the group. But Genoa's AutoCAD driver does support Release 12; Cirrus Logic's AutoCAD

Graphics Accelerators: Facts at a Glance

CONTINUES

Diamond Computer Systems Inc.

1130 E. Arques Ave., Sunnyvale, CA 94086; 408-736-2000; fax, 408-730-5750

Diamond Stealth Pro

List price: With 1MB VRAM, \$349. 2MB VRAM and RAMDAC upgrade, \$150.

CIRCLE 478 ON READER SERVICE CARD

In short: The S3 86C928-based Diamond Stealth Pro garnered high test scores under Microsoft Windows, but it was not such a well-rounded DOS or AutoCAD performer. At \$349, this sturdy, easy-to-install board is worth the consideration of Windows users.

Diamond Stealth 24

List price: With 1MB DRAM, \$249.

CIRCLE 479 ON READER SERVICE CARD

In short: A good performer under Microsoft Windows and DOS, the S3 86C801-based Diamond Stealth 24 was one of the slower AutoCAD performers in its class.

Edge Technology Inc.

915 E. Karcher Rd., Nampa, ID 83687-3045; 800-438-3343, 208-465-3434; fax, 208-465-3424

Edge D24 BitBlaster Plus

List price: With 1MB DRAM, \$99.

CIRCLE 480 ON READER SERVICE CARD

In short: If you're willing to compromise Microsoft Windows and AutoCAD performance for a low price, the Cirrus Logic GD5426-based Edge D24 BitBlaster Plus is a bargain at \$99. Like other boards with this chip, the Edge delivered solid DOS performance.

ELSA America Inc.

400 Oyster Point Blvd., #109, South San Francisco, CA 94080-1917; 800-272-3572, 415-615-7799; fax, 415-588-0113

ELSA Winner 1000

List price: With 1MB VRAM, \$548.

CIRCLE 481 ON READER SERVICE CARD

In short: The dual-identity \$548 ELSA Winner 1000 can support EISA or ISA setups. In its EISA mode, this S3 86C928-based board garnered some of the best Microsoft Windows scores of its class when in 256-color mode.

Focus Information Systems Inc.

4046 Clipper Ct., Fremont, CA 94538; 800-925-2378, 510-657-2845; fax, 510-657-4158

Focus 2 the Max TrueSpeed

List price: With 1MB DRAM, \$199; with 2MB DRAM, \$239.

CIRCLE 482 ON READER SERVICE CARD

In short: The Focus 2 the Max TrueSpeed was second-fastest of the S3 86C801-based boards in AutoCAD, despite its generic S3 driver, and turned in acceptable benchmark test scores elsewhere. The low price makes this board a worthwhile value.

Genoa Systems Corp.

75 E. Trimble Rd., San Jose, CA 95131; 800-934-3662, 408-432-9123; fax, 408-434-0997

Genoa WindowsVGA 24

List price: With 1MB DRAM, \$179.

CIRCLE 483 ON READER SERVICE CARD

In short: Although it was the best performer among the Cirrus Logic GD5426-based boards we tested, the \$179 Genoa WindowsVGA 24 can't compete with the Microsoft Windows and AutoCAD performance available from other chip classes.

Genoa WindowsVGA 24+

List price: With 1MB DRAM, \$249.

CIRCLE 484 ON READER SERVICE CARD

In short: Although the Genoa WindowsVGA 24+ was remarkably quick at AutoCAD, outpacing more expensive products, this S3 86C801-based board displayed remnant pixels under AutoCAD and was a subpar performer under Microsoft Windows.

Hercules Computer Technology Inc.

3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112

Hercules Graphite Card

List price: With 1MB VRAM, \$399.

CIRCLE 485 ON READER SERVICE CARD

In short: The \$399 Hercules Graphite Card was the only reviewed card based on the IIT AGX-014. Its strong Graphics Winmark scores were produced by drivers that bypassed portions of our benchmark tests, putting its performance in a poor light.

Hercules Superstation XP610

List price: With 1MB VRAM, \$995.

CIRCLE 486 ON READER SERVICE CARD

In short: This board's Microsoft Windows performance can't be compared with that of the other boards, and its AutoCAD performance could not best that of the fastest accelerators.

Linwen Associates Inc./Gaintec

1715 RFD, Long Grove, IL 60047; 708-541-0965; fax, 708-541-0966

Linwen/Gaintec GXA

List price: With 1MB VRAM, \$220.

CIRCLE 487 ON READER SERVICE CARD

In short: The \$220 Linwen/Gaintec GXA is the least expensive of the S3 86C924-based boards we tested. It also provides decent performance for this chip class, though it lacks 24-bit color support. Even so, there are better bargains based on other chips.

Matheus Corp.

1600 NW Compton Dr., Beaverton, OR 97006-6905; 800-638-4387, 503-690-1550; fax, 503-690-1525

Matheus Premier 801

List price: With 1MB DRAM, \$299.

CIRCLE 488 ON READER SERVICE CARD

In short: The Matheus Premier 801, based on the S3 86C801 chip, has a higher-than-average price that is not justified by its average Microsoft Windows performance. If you can find it at a discount, though, this board could be a worthwhile choice.

Now
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limits of
the system.

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Run DOS applications.

Run Windows™

applications. Run OS/2® applications. Run

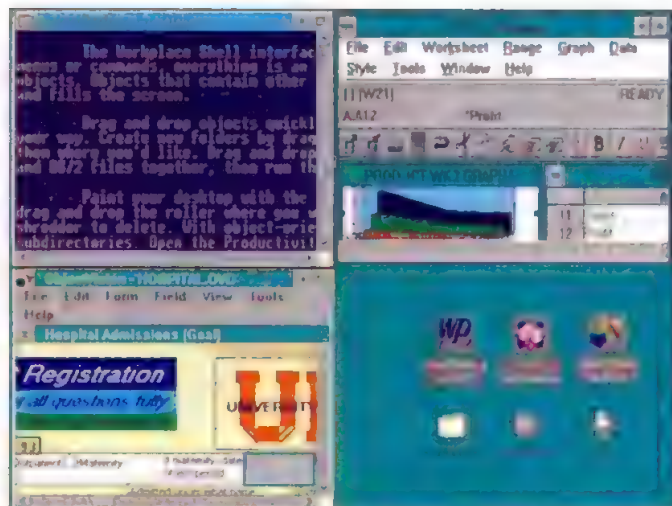


them at the same time, in separate windows on the same screen.

With OS/2, you can experience a whole new level of freedom

and flexibility.

Drag a file object from one folder and drop it in another to move it. Drag a folder



DOS and Windows support is built in to OS/2, and you can explore over 1,000 OS/2 applications as well.

object and drop it on the shredder to delete it. Drag a file object and drop it on the printer to print it. In the OS/2 Workplace Shell,™ common procedures become intuitive clicks of a mouse.

Copy text from DOS applications into Windows or OS/2. Or from anywhere to anywhere. Use Dynamic Data Exchange within or between OS/2 and Windows applications. Repaginate a Word for Windows document while printing a Harvard Graphics® chart while calculating a 1-2-3® spreadsheet while downloading files via modem. Instead of calling a file "boblettr.622," call it anything you want up to 256 characters long. Instead of



OS/2 Advantages:

Easy to use.

- Object-oriented Workplace Shell interface.

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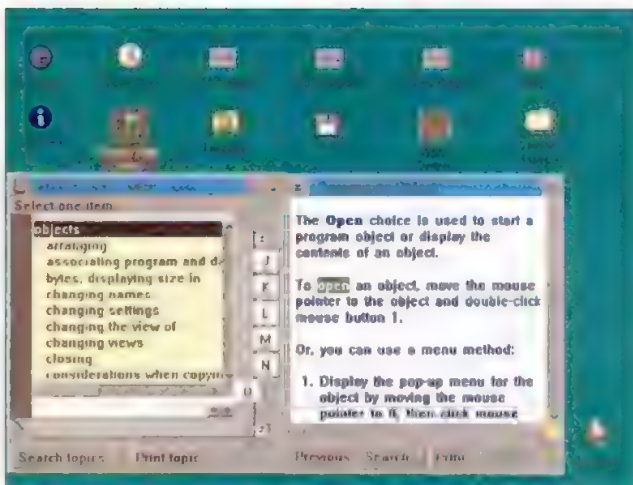
With OS/2, you can stop dealing with the limitations of the past, and start rising above them.

higher

working within the 640K barrier, take advantage of more of your computer's memory.

Use the PMSeek feature to search for files. Use the built-in ICON editor to custom-design your own icons. Use the Productivity Alarms object to schedule automatic backups,

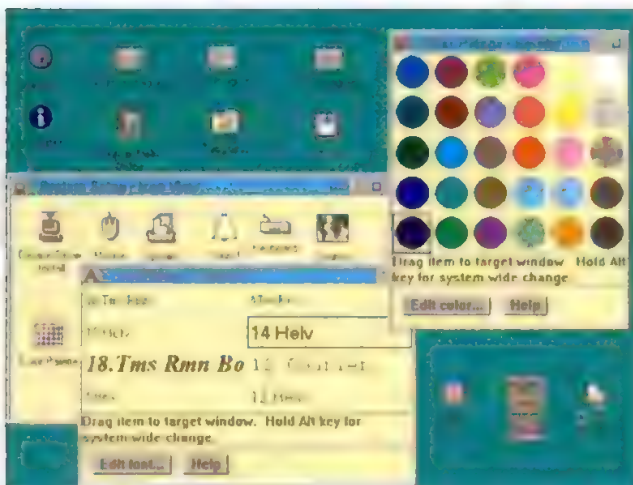
level.



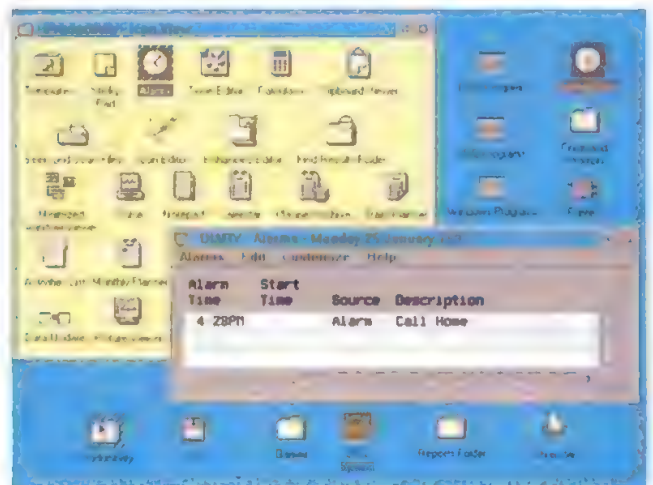
In the Workplace Shell, everything appears as an object. It's a simple, intuitive, more efficient way to work.



With built-in networking features, OS/2 was designed to excel in both standalone and connected environments.



Organize and customize your desktop to look and work the way you want it to.



You can set alarms to remind you of events with the Alarms function in the Productivity folder.



HARDWARE

Graphics Adapters

driver supports Release 11.

There are some differences among the four boards, including DRAM speed. The boards from Cardinal and Edge used 45-ns DRAMs, while those from Genoa and Boca used 70-ns chips. (By the time you read this, Cardinal Technologies expects to have changed the DRAM on its VideoSpectrumXL from 45 ns to 60 ns; the company's tests show that the difference in performance is not worth the increased cost.)

All of the GD5426-based boards proved easy to install into the test system. Software installation is generally the same for the Boca, Cardinal, and Edge boards, which use a utility from Cirrus Logic called CLMODE to set the desired resolution and colors. The Genoa WindowsVGA 24 includes its own installation program and utilities. But unlike the problems encountered with Genoa's 801-based board, the setup utilities for the WindowsVGA 24 worked without a hitch.

All four GD5426-based boards include a convenient utility for Windows 3.1 called SetRES that lets you change the screen resolution and number of screen colors, and select either large or normal fonts by pointing and clicking buttons. The Genoa WindowsVGA 24 comes with two additional software utilities that are not included with the other boards. One is a program called SYNC that lets you configure the Windows-VGA 24 card so that it matches the refresh rate of the monitor and lets you center the screen manually to adjust for monitor differences. The other utility is Safescan, a Windows utility that lets a monitor be overscanned while maintaining a safe region within which application programs can operate.

As a group, the Cirrus Logic GD5426-based video accelerator boards did not perform well against the competition, with the exception of their solid DOS performances. With their near bottom-of-the-heap performance in Windows and AutoCAD, these boards have their greatest appeal in terms of price. If you are looking for a video board that provides a small degree of Windows acceleration at the most affordable price, the BitBlaster 24 Plus is the best choice of these four.

Graphics Accelerators: Facts at a Glance

ENDS

Metheus Corp. (continued)

Metheus Premier 928-4M

List price: With 1MB VRAM, \$399; with 2MB VRAM, \$549; with 4MB VRAM, \$929.

CIRCLE 489 ON READER SERVICE CARD

In short: The only tested board with 4MB of VRAM, the \$929 Metheus Premier 928-4M supports up to 1,600-by-1,200 noninterlaced resolution at up to 256 colors, though its performance was not up to that of some of the other S3 86C928-based boards.

MicroStep Inc.

15358 E. Valley Blvd., City of Industry, CA 91746; 818-336-8991; fax, 818-336-5170

MicroStep AGC-2075e

List price: With 2MB VRAM, \$895.

CIRCLE 490 ON READER SERVICE CARD

In short: This board is not quite ready for prime time, marred by a cumbersome installation, poor Microsoft Windows test results, and the inability to run our AutoCAD tests.

Mirage Computer Systems, a division of General Business Machines

119 S. Bundy Dr., Los Angeles, CA 90049; 800-228-3349, 310-440-1460; fax, 310-476-6839

Mirage Storm 1280/256

List price: With 1MB DRAM, \$249; with 2MB DRAM, \$295.

CIRCLE 491 ON READER SERVICE CARD

In short: A highly respectable performer under DOS and Microsoft Windows, the S3 86C801-based Mirage Storm 1280/256 lags in terms of AutoCAD text zooms.

National Design Inc.

1515 Capital of Texas Hwy. South, 5th Floor, Austin, TX 78746; 800-253-8831, 512-329-5055; fax, 512-329-6326

National Design Volante AT800

List price: With 1MB VRAM, \$795.

CIRCLE 492 ON READER SERVICE CARD

In short: A high price, poor Microsoft Windows performance, AutoCAD performance on a par with lower-cost accelerators, and a maximum of 256 colors in all resolutions keep the National Design Volante AT800 from being a threat to other boards in this review.

Nth Graphics Ltd.

1908 Kramer Ln., Suite A, Austin, TX, 78758; 800-624-7552, 512-832-1944; fax, 512-832-5954

Nth S3 Advantage

List price: With 1MB DRAM, \$595.

CIRCLE 493 ON READER SERVICE CARD

In short: The Nth S3 Advantage's high price buys a feature-laden AutoCAD display-list driver. Otherwise, this S3 86C801-based product ranks in the middle of the pack.

Number Nine Computer Corp.

18 Hartwell Ave., Lexington, MA 02173; 800-438-6463, 617-674-0009; fax, 617-674-2919

Number Nine #9GXE

List price: With 1MB VRAM, \$495; with 2MB VRAM, \$695; with 3MB VRAM, \$895.

CIRCLE 494 ON READER SERVICE CARD

In short: The \$495 Number Nine #9GXE brought in the highest Microsoft Windows scores of this roundup, but it uses text string caching to reach this level of performance, which puts these scores in an unfavorable light.

Orchid Technology Inc.

45365 Northport Loop, West Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312



Orchid Fahrenheit VA

List price: With 1MB DRAM and audio, \$299

CIRCLE 495 ON READER SERVICE CARD

In short: The top S3 86C801-based Microsoft Windows performer, the Orchid Fahrenheit VA also provides excellent DOS performance and adds microphone input and stereo outputs to your system.

Personal Computer Graphics

3914-901 Del Amo Blvd., Torrance, CA 90503; 800-255-9893, 310-214-0550; fax, 310-214-8570

PCG Photon 70/70 Deluxe

List price: With 1MB VRAM, \$495. 2MB VRAM upgrade, \$100; 24-bit RAMDAC upgrade, \$20

CIRCLE 496 ON READER SERVICE CARD

In short: The \$495 PCG Photon 70/70 Deluxe has extensive AutoCAD utilities, including a magnifying window with real-time zooming, and enhanced display-list erasing. Still, you can find other S3 86C928-based boards that cost about the same but are better performers.

SixGraph Computing Ltd.

5 Harborview Dr., Hingham, MA 02043; 617-740-0032; fax, 617-740-4081

SixGraph Wizard 924

List price: With 1MB VRAM, \$295.

CIRCLE 497 ON READER SERVICE CARD

In short: If you're planning to use AutoCAD heavily, consider the \$295 SixGraph Wizard 924. It is a real find because of its price and solid AutoCAD performance (it outperformed all but one of the more expensive S3 86C928-based boards in terms of the total time for the AutoCAD tests)

Video Seven

46305 Landing Pkwy., Fremont, CA 94538; 800-238-0101, 510-656-7800; fax, 510-659-9285

Video Seven WIN.PRO

List price: With 1MB DRAM, \$249.

CIRCLE 498 ON READER SERVICE CARD

In short: Undistinguished among its S3 86C801-based peers, the Video Seven WIN.PRO will still outperform most other graphics accelerators under Microsoft Windows. It is an eminently usable if unremarkable product.

THE LONE WEITEK PLAYER

• ASL Lightning SVGA

BY HENRY FERSKO-WEISS
AND STEPHEN W. PLAIN

The \$199 ASL Lightning SVGA from Alpha Systems Labs was the only board we tested that uses the Weitek W5286 chip. But this board's Windows performance—particularly at 256 colors—was at the low end of the spectrum.

The Weitek W5286 chip has an 8-bit internal data path and a 32-bit data path to video memory. Although the chip is hardware-capable of running at 1,280-by-1,024 interlaced, no drivers were available for the ASL board for this resolution at the time of our testing. In addition, there were no drivers for AutoCAD or, as was the case with many other boards, for OS/2.

In addition to its poor Windows

scores—it bested the low scores of the Cirrus Logic GD5426-based accelerators in 16-color modes only—a special utility is required to switch resolutions in Windows (instead of Windows' Control Panel). The ASL board was also visibly slower than the other boards in applications testing.

Since it does have an acceptable DOS Video score of 3,455 thousands of operations per second, you may consider Alpha Systems Labs' ASL Lightning VGA for strictly DOS applications. However, at a \$199 list price (around \$170 on the street), it certainly faces some tough competition from faster DOS performers that are based on the Cirrus Logic GD5426 chip or its nonaccelerated sibling, the GD5422 chip.

COPROCESSED PERFORMANCE

- Hercules Superstation XP610
- MicroStep AGC-2075e
- National Design Volante AT800

BY JAMES KARNEY

The strides being made in accelerator-chip design might lead you to believe that the aging Texas Instruments TMS34020 has seen its day. But it is still considered a contender for computer-aided design and for applications requiring high-resolution true color. The reason is simple: The TMS34020 is a fully programmable 32-bit microprocessor. As such, it offers the standard functions you get on a fixed-function accelerator: bit-block transfers, line draws, and raster operations. By writing custom code, you can also enlarge the features set to include arc and ellipse operations (among other things). When it comes to optimizing performance, board makers have a lot more flexibility with a full processor.

Top-of-the-line true-color cards such as the Matrox Impression AT/S, Matrox Impression Ultra, and Hercules Chrome really push the chip and come with lots of video RAM, advanced RAMDACs, and special drivers. But you'll pay from \$1,295 to \$3,595 for these cards' ability to provide 16.7 million colors at resolutions ranging from 1,024-by-768 to 1,600-by-1,200.

With tailored display-list processors, cards using the TMS34020 can also give outstanding CAD performance (the \$995 TMS34020-based National Design Volante AT1000 had the best total AutoCAD score when tested for our January 12, 1993, issue). But some of the other designs mentioned in this story are closing the gap.

We review three TMS34020-based

cards: the Hercules Superstation XP610, the MicroStep AGC-2075e, and the National Design Volante AT800. All cost under \$1,000 in their base configurations, and all rely on pass-through VGA. So in most cases, be ready to reserve a second slot for a complete display setup.

HERCULES SUPERSTATION XP610

Prices for the 16-bit ISA Hercules Superstation XP610 card start at \$995 (about \$700-\$800 on the street), with 1MB of 80-nanosecond VRAM (although the card we saw used slower 100-ns VRAM). The board, which is only FCC Class A-rated, also includes a 24-bit TI RAMDAC. You get 16.7 million colors at 1,024-by-768 noninterlaced resolution if the board is equipped with 4MB of VRAM, VGA and Super VGA resolutions with 2MB of VRAM, and a nonstandard 512-by-480 with 1MB of VRAM. With 1MB at 800-by-600, 32K colors are available. Unlike the older Graphics Station Gold series, the Superstation provides Microsoft Windows 3.1 drivers for true-color modes. As with the other TMS34020-based cards here, no OS/2 drivers are available.

Maximum displayable resolution is 1,600-by-1,200 interlaced at 16 colors with 1MB; with 4MB, you max out at 32K colors at this resolution. The 1MB-equipped Superstation comes with an 85-MHz pixel clock and supports up to an 80-Hz vertical refresh rate at 1,024-by-768 and up to a 90-Hz refresh rate at 800-by-600. The 700 series of the Superstation sports a 135-MHz pixel clock that allows higher refresh rates at resolutions above SVGA.

We had no problems getting everything up and running for both Windows and AutoCAD operations. We noticed only one anomaly when running Windows 3.1: The opening icon displayed in a strange magenta color. But once the regular desktop loaded, the color scheme returned to normal. The product has a couple of other quirks: You must, for example, use Hercules' proprietary utility rather than the Windows Control Panel in order to change modes under Windows. You do, however, get Hercules' BigMap hardware pan, which lets you easily move around the entire contents of a spreadsheet or document. In 256 color modes under Windows, the Super-

station was slow when compared with most of the accelerated group.

In AutoCAD, the board's total time of 74.05 seconds could not beat the speedy performance of the Artist Graphics WinSprint 900 Lite or the Genoa WindowsVGA 24+ accelerators.

Hercules has its own display-list processor driver and incorporates the same Spyglass magnifier window and bird's-eye global pan that were so successfully implemented on its Graphics Station Gold series.

Shifting to 4MB of VRAM and 2MB of dynamic RAM pushes the cost up to \$1,595 (and changes the model number to XP624)—a sum well out of the range of accelerators. (You can get up to 16MB of DRAM for \$2,595.) The DRAM gets you TIGA program storage, font caching under Windows, and display-list storage under AutoCAD. Finally, an NTSC and PAL digital encoder is available for \$295 if purchased as a separate option.

MICROSTEP AGC-2075e

The \$895 EISA-based MicroStep AGC2075e comes with 2MB of VRAM and 1MB of DRAM (expandable to 4MB). It supports noninterlaced resolutions of 1,280-by-1,024 and 1,024-by-768 with 256 colors. It can also support 1,024-by-768 resolution at 64K colors if you add the optional TLC34076 RAMDAC. At resolutions of 640-by-480 and a non-standard 512-by-512, the TI TLC34075 RAMDAC-equipped board supports up to 16.7 million colors in its base configuration. (A 16-bit ISA version of the board, the \$795 MicroStep AGC-2075+, supports the same; we received this board for testing but were unable to get it to function.) The EISA version supports two different daughtercards accommodating up to 8MB or 32MB of DRAM. It can handle a 75-Hz refresh rate at its highest resolution. The unit includes a SuperWin mode, which lets you create a virtual 2,048-by-2,048 viewing area that can be panned and scrolled in Windows.

On the down side is the cumbersome installation, which involves an inflexible interface that made it taxing to confirm a variety of settings and choose a firmware-fixed resolution. Also detrimental is the unusual way the board connects to the required VGA card. You have to at-

tach a special cable from the back of the MicroStep to the second adapter and then run a setup routine.

The MicroStep uses the TIGA Windows driver available on the Windows disks and a standard AutoCAD driver. On our Windows test (the board supported only 1,024-by-768, 256-color drivers), its score of 6.13 megapixels per second was clearly on the bottom rung for EISA boards and only slightly better than the performance you can eke out of a 924-based board at that resolution and color depth. Also, during Windows testing, the card produced a corrupted screen while drawing a spreadsheet in Excel. Worse yet for a coprocessor, the board hanged on our attempts to run AutoCAD tests. The MicroStep is too rough around the edges to recommend at this time.

VOLANTE AT800

The \$795 National Design Volante AT800 is a close but stripped-down relative of the Volante AT1000 that we reviewed in our January 12, 1993, issue. The main differences are that the Volante

AT800 requires the addition of a VGA card connected via a dual-pin feature adapter, uses a Brooktree (rather than a Samsung) RAMDAC, comes with slower (100-ns) VRAM, supports a maximum 1,024-by-768 interlaced and non-interlaced resolution, and provides up to 256 display colors at all resolutions.

The board sports a clean design, but the setup routine was a bit cumbersome. It uses NDI's modified version of the Microsoft TIGA drivers and ships with Vibrant Graphics' DL-Xpress/386 2.0 display-list processor driver. DL-Xpress boasts anti-aliasing and a True-Erase feature that removes deleted objects rather than covering them. In testing, screen draws were smooth, and we saw no artifacts of color images.

In AutoCAD testing, the board closely matched the performance of the leading (and often lower-cost) accelerators. Its scores on our Windows benchmark tests were not competitive with most of these options, however. If Windows speed is what you need, faster, lower-cost alternatives are available. □

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THE IMAGE CRUSADERS:

12 Screen Capture & Conversion Utilities



by Lori Grunin

In an industry that considers the invisibility of underlying technology—reverently referred to as “transparency”—the ultimate achievement, it’s ironic that we should still have to think about something as basic as file formats. But we do.

Graphics file formats formally evolve in order to accommodate more sophisticated needs, and developers exploit holes in specifications to create customized versions of common formats. Unfortunately, the applications that need to use these files, such as desktop publishing or presentation graphics programs, can’t alter their file import mechanisms quickly enough to prevent a certain level of user frustration. And where there is user frustration, utilities are sure to follow.

The utilities that we look at here are designed to serve at least two purposes: to allow users to convert among a variety of graphics file formats (to be in this story, a program had to support a minimum of .PCX and TIFF, as well as 15- and 24-bit color images) and to perform screen captures. Twelve products made the cut: Conversion Artist (North Coast

If your application can’t read your image files, try one of these 12 programs to create a perfect fit.

IN THIS REVIEW

Conversion Artist	238
DoDOT	239
FreezeFrame	240
HALO Desktop Imager	241
HiJaak	243
HiJaak for Windows	243
ImagePals	249
ImagePrep	249
Paint Shop Pro for Windows	254
PictureEze with CaptureEze	226
Pizazz Plus	226
Window Painters’ SnapPRO!	258
Summary of Features	232

GRAPHICS

Conversion Utilities

Suitability to Task: Screen Capture and Conversion Utilities

While all of these products are designed to perform similar functions, they accomplish these tasks with varying degrees of success. Instead of choosing just one, you may want to choose two or three to round out your graphics toolbox.

To evaluate these 12 screen capture and conversion utilities, we asked them to do what they're designed for: capturing and converting.

The first part of our test suite called for the packages to perform both DOS and Windows captures, where possible; we then opened the captures in either Aldus PageMaker, Micrografx's Picture Publisher, or QuarkXPress for Windows to verify their results. We performed full-screen, region, and freehand Windows captures, as well as full-screen and area captures of a spreadsheet under DOS.

The second set of tests evaluated the packages' ability to convert files from one raster format to another. The packages were called upon to convert a series of TIFF files, in a variety of color depths and flavors, to .PCX format. Next, we asked the packages to convert Targa and .PCX files to uncompressed TIFF. Those packages that could handle Amiga .IFF files

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	○	○	○
Raster file conversion	●	●	○	○
Vector file conversion	●	●	●	○
Image processing	●	●	●	●
File management	N/A			

N/A—Not applicable: The product does not perform this task.

were also asked to convert this format.

The third part of our testing evaluated the packages' ability to convert from one vector format to another. Here, we converted an array of CGM and .WMF files to EPS format, GEM files to CGM format, and EPS files to .WMF format. If a package could read Macintosh Pict files, we converted them to .WMF format.

After the conversions were completed, we printed the resulting raster and vector files on a Tektronix Phaser II PXi color PostScript printer, using each package's batch-processing capabilities where possible.

The fourth and final part of our testing evaluated the packages' ability to perform image processing. Here, we tested the packages' skill at reducing a 24-bit color TIFF file to 8-bit color and then reducing the 8-bit file to 4 bits,

using whatever dither and halftone options were available. Another test called for the packages to reduce an 8-bit color file to 8-bit gray-scale. We also tested the cropping tools of the packages and assessed their file management schemes for how effectively they let you catalog images.

For a package to excel at **screen capture**, the resulting captures must be true to the originals in scale and color and readable by other applications. It should also offer customizable capture configurations, especially for capturing to a variety of file formats via user-defined hotkeys. Windows capture programs must also offer flexible controls for designating capture areas.

In evaluating **raster file conversion** and **vector file conversion**, the breadth of supported formats and the quality of conversion from one format to another are the primary considerations. Also important are batch-processing capabilities and the appearance and readability of the converted files.

To succeed at **image processing**, a package needs to offer basic image controls, such as brightness and contrast, color and gray-scale correction, and palette inversion. The best products will offer additional controls, such as scaling, rotating, and flipping, and special effects, like sharpening, softening, and posterizing. Another major consideration is the ability to handle color reductions flexibly and reliably.

The ability to perform **file management**—moving, renaming, and manipulating your image files—via thumbnails, image albums, or simple file lists can greatly increase your image-handling productivity.

Software), DoDOT (Halcyon Software), FreezeFrame (DeltaPoint), HALO Desktop Imager (Media Cybernetics), HiJaak and HiJaak for Windows (Inset Systems), ImagePals (U-Lead Systems), ImagePrep (HSC Software), Paint Shop Pro for Windows (JASC), PictureEze with CaptureEze and Pizazz Plus (Application Techniques), and Window Painters' SnapPRO! (Window Painters).

Two of these products—HiJaak and Pizazz Plus—run under DOS, and the rest run under Microsoft Windows. Only three companies offer capture programs for OS/2, all with *extremely* limited conversion capabilities. Two are shareware: Clip (\$20; available for download as CLIP11.ZIP in the OS/2 Utilities data library of the IBMSYS forum on CompuServe or from Dynalink Technologies,

P.O. Box 593, Beaconsfield, Quebec, Canada H9W 5V3; 514-630-7663) and Nikon II (\$49; available for download as NIKON.ZIP in the Unix and OS/2 data library of the Zenith forum on CompuServe or from Bitware, Software & Services, P.O. Box 3097, Manuka A.C.T. 2603, Australia). The last is Collage PM (\$199; Inner Media, 60 Plain Rd., Hollis, NH 03049; 603-465-3216).

Many products did not make it into this review, for a variety of reasons. Collage Complete (for DOS and Windows), Collage PM, and the DOS-based Hot-

Shot Graphics (\$249; Symsoft, Call Box 5, Incline Village, NV 89450; 702-832-4300) all have new versions coming out in the near future. FullShot (\$100; InBit, P.O. Box 391674, Mountain View, CA 94039; 800-227-1788) lacks 24-bit color support. ArtWorks (\$150; R Company, 10530 Santa Monica Blvd., Los Angeles, CA 90025-4951; 310-393-3043), Image Alchemy (\$79.95; Handmade Software, 15951 Los Gatos Blvd., #17, Los Gatos, CA 95032; 408-358-1292), and Images Incorporated (\$299; Iterated Systems, 5550 Peachtree Pkwy., #650, Norcross, GA

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EDITORS' CHOICE

- **Conversion Artist**
- **HiJaak for Windows**

30092; 404-840-0310) don't perform screen captures. Jewell Technologies chose not to submit its product, The Juggler, for review, and ICE International's Snap-It (\$49; 10 Bure Close, Brickhill, Bedford MK417TX, England; +44-234-327-117) never arrived.

The products in this category vary substantially in price—from \$49 to \$249—but they also vary substantially in capability. While some products offer basic capture and conversion, others offer an extensive range of supported file formats, basic image-processing capabilities, special printing capabilities, or image management functions.

FORMATS KEEP CHANGING

Even for programs dedicated to conversion, keeping up with the different formats is no mean feat. TIFF (Tagged Image File Format) has undergone six revisions since Aldus Corp. introduced it in 1986. Version 1.0 supported monochrome only; Version 6.0 supports monochrome, gray scale, various color depths, several compression schemes, and the colorimetric data used by emerging color management systems. At this point, few products support TIFF, Version 6.0; as of this writing, ArtWorks is the only program we've seen that does.

ZSoft's .PCX format has also increased its color support over time, but the format is renowned for the way developers play fast and loose with palette placement and header information. And these utilities don't necessarily report the header information identically. For instance, .PCX has run length encoding (RLE) compression built-in. Some programs report that a .PCX file is compressed, while others report that it isn't; thus, just diagnosing an incompatibility problem can be a problem in itself. (For more information on problems you may encounter during file conversion, see the sidebar "Troubleshooting Conversions.")

And just when you thought there were plenty of formats, a few new ones have popped up. *Lossy compression*—shrinking file size by making judicious trade-offs between image size and image quality—is starting to gain supporters. Two of the products in this story support

For sheer breadth of supported raster file formats, nothing comes close to Conversion Artist and HiJaak for Windows. These two Windows capture and conversion specialists can elegantly handle virtually any raster files you throw at them, including some

of the more unusual types.

The \$149.95 Conversion Artist is a raster master. This offering from North Coast Software supports more raster formats than even HiJaak, including non-PC formats such as Silicon Graphics RGB and Sun RAS. Its raster file conversions are clean and true to form, its screen captures are attractive, and its interface is so well designed that you may never need to open the manual. Everything from color reductions to batch processing can be accomplished with a few clicks of the mouse. What Conversion Artist cannot do, however, is work with vector files. In addition, it has some difficulty working with exceptionally large files, such as our 14MB test image.

If you need to work with both raster and vector files, you'll want to turn to the \$249 HiJaak for Windows, from Inset Systems. The scope of this product can truly be called encyclopedic: it supports all the usual file formats, as well as some of the less common but equally important formats, such as HPGL and AutoCAD .DXF. And its support for the myriad flavors of CGM is both comprehensive and well implemented: You simply select the name of the application into which you intend to import the file. Best of all, its conversions, color reductions, and screen captures all turn out well. Its interface may not be the most elegant and its batch-processing capabilities are somewhat limited, but HiJaak can get the job done.

You might do well, though, to look at these utilities not as the ultimate solution to all your needs but as tools

to add to your graphics toolbox. No one package is liable to give you all the functionality you need.

If you're willing to purchase more than one product, consider the \$169 HALO Desktop Imager from Media Cybernetics, which offers the slickest interface in the group, a strong set of image-editing tools, and stable captures and conversions. Its only drawback is the limited number of file formats it supports. Also worth considering is U-Lead Systems' \$249 ImagePals, which offers a well-designed set of capture tools and an elegant photo-album solution to file management; like HALO, however, it supports only a limited array of raster formats. And don't overlook the \$49 Paint Shop Pro for Windows, from JASC. Its price may be low, but it has the skill, if not the breadth, of its pricier competitors.

If you haven't made the jump to Windows, consider the \$249 HiJaak from Inset Systems and the \$149 Pizazz Plus from Application Techniques. These DOS-based packages offer a good array of conversion options and are well worth considering.

The remaining Windows-based products in this review all offer a mixed bag. DoDOT (\$189, from Halcyon Software), FreezeFrame (\$89.95, from DeltaPoint), ImagePrep (\$99, from HSC Software), PictureEze with CaptureEze (\$149, from Application Techniques), and Window Painters' SnapPRO! (\$69.95, from Window Painters) all proved capable at screen capture but have difficulty converting some file types.

■ Putting the Squeeze on Images

by Lori Grunin

When it comes to file sizes, smaller is always better, except when something gets lost in the translation. *Lossy* image compression—a type of raster image compression that throws out the “least visually important” data in an image based on some user-defined threshold—lets you shrink a file to a fraction of its original size. But finding the optimal size can be frustrating.

Four of the products in this story offer lossy file compression (Conversion Artist has a \$99 JPEG option). HALO Desktop Imager and ImagePals can produce industry-standard JPEG (Joint Photographic Experts Group) files, while Paint Shop Pro for Windows' JAS format and ImagePrep's OIC (Optimized Image Compression) are both proprietary methods. The techniques used by both JPEG and the proprietary implementations, however, are all based on the same procedure, known as a Discrete Cosine Transform (DCT).

Before compressing an image, the software converts the RGB or gray-scale information into another color space known as YUV. In the YUV space, all the important resolution information of an image is in the Y (luminance) channel, while the color information is translated into two other channels, U and V.

The compression algorithm then shrinks the amount of information from each channel it will be working with, a process referred to as *subsampling*. For example, 4:4:4 subsampling means that the software is using 4 bits of information from each channel (this is the maximum); 4:1:1 subsampling means that for every 4 bits of luminance data it uses, the program will use 1 bit of U data and one bit of V data.

WHAT ARE THE OPTIONS?

Most simple implementations of lossy compression, such as those found in these products, present a sliding scale that gives the user a choice of “compression level” or “compression factor.” In JPEG, that scale runs from 1 to 100; Paint Shop Pro's runs from 1 to 99, and ImagePrep's runs from 1 to 20.

Only ImagePals gives you the additional option of choosing the subsampling rate. You can choose among None, 4:2:2, and 4:1:1, and the amount of compression you gain from using a lower subsample rate decreases as the compression level increases. For example, on an 8.5MB file, using 4:1:1 subsampling at a

compression level of 25 yielded a difference of 48K; at a compression level of 100, the difference shrank to about 12K.

Unfortunately, finding the optimal compression level is a bit of an esoteric art, because the scales aren't linear and because they produce different results across different packages. For instance, HALO Desktop Imager and ImagePals both use JPEG compression on similar scales. But HALO required a level of 25 to achieve approximately 30:1 compression on a 1.3MB file, while ImagePals needed a setting of 40 (both using 4:1:1 subsampling).

We compressed a variety of images of different sizes and content. All of the images shown here were compressed at a rate of about 30:1, with no perceptible degradation. If you split the images into their hue, saturation, and lightness channels, you can see how information was discarded from the color (hue and saturation), while the luminance data is preserved.

HALO Desktop Imager's compression seemed to work the best, offering the highest compacting with the least amount of degradation; the JPEG compressors performed significantly better than the proprietary ones overall. We achieved as much as 150:1 compression in some cases, but keep in mind that maximal compression levels generally yield unusable results. And if you need to compress many large files—around 10MB or more—you should spring for an add-in board with either a JPEG or DSP chip on it to hasten things along.

Many standalone applications are also implementing JPEG support, especially image-editing packages such as Aldus PhotoStyler and Picture Publisher. Just as some of the utilities vendors have done, the developers of these applications have licensed JPEG compression routines from third parties, such as C-Cube Microsystems or Xing Technologies.

Knowing the source of the JPEG filter can help when you are having trouble opening an image compressed by another application. In many cases, you can find out by checking in the About box (under the help menu) or hitting F1 sometime into the Save As process. In addition to file format incompatibilities, a JPEG compressor may not be able to handle large files or files that are beyond a certain number of pixels horizontally or vertically.



KEY

Each block of images depicts the compressed image followed by the luminance, the saturation, and the hue channel of that image (clockwise from upper left).



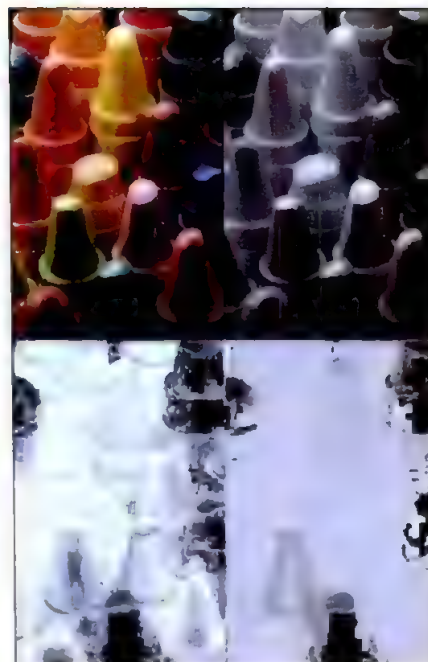
ORIGINAL

Size: 1,338,442 bytes.
No compression.
No subsampling.



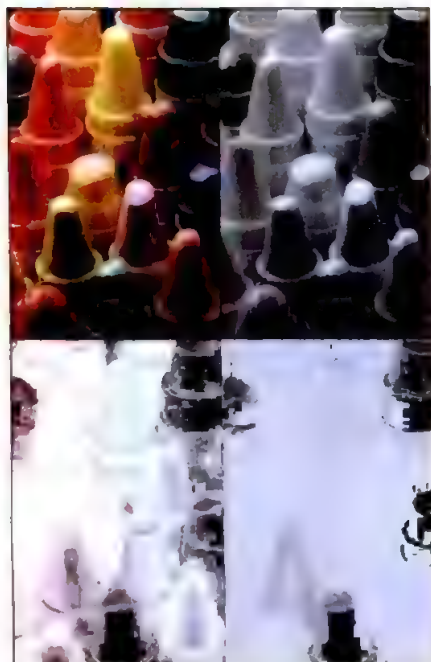
HALO DESKTOP IMAGER

Media Cybernetics JPEG algorithm.
Size: 41,343 bytes.
Compression factor = 25.
Subsampling = 4:1:1 (fixed).



IMAGEPALS

C-Cube/U-Lead JPEG algorithm.
Size: 45,433 bytes.
Compression level = 40. Subsampling = 4:2:2
(user-selectable).



IMAGEPALS

C-Cube/U-Lead JPEG algorithm.
Size: 40,440 bytes.
Compression level = 40. Subsampling = 4:1:1
(user-selectable).



IMAGEPREP

Proprietary OMC algorithm.
Size: 43,977 bytes.
Compression level = 15. Subsampling
undetermined (fixed).



PAINT SHOP PRO FOR WINDOWS

Proprietary algorithm.
Size: 40,060 bytes.
Compression level = 99. Subsampling
undetermined (fixed).

JPEG compression, while two others use proprietary precursors to the JPEG standard. Images Incorporated offers Iterated Systems' fractal compression. (For a look at the lossy compression capabilities of the products, see the sidebar "Putting the Squeeze on Images.") JPEG has finally spawned a fairly standardized file format, known as JFIF—JPEG Interchange File Format.

Another raster format that's gaining supporters is Kodak's PhotoCD, although only two of the products we review here offer PhotoCD capability (read-only, of course).

The problems you experience can increase exponentially as you increase the number of supported file formats. Some vendors are emulating Inset Systems—which offers the largest selection of formats—by adding vector-to-vector and vector-to-raster file conversion capabilities to their products. While combining the two types of formats in a single utility is a sensible idea, it doesn't necessarily imply that a program's algorithms for converting vector formats is as robust as its algorithms for converting raster formats or vice versa.

You may even find that a product with excellent TIFF conversion capabilities can't open a multitude of .PCX flavors. Or you'll discover that a product that competently converts a host of formats may have poor color reduction, arguably one of the most important capabilities of these products. The ability to convert the palette of a 15-bit or 24-bit image into the best possible set of 256 colors is essential for image-rich presentations, and finding the optimal translation into gray scale can make or break publication output on a monochrome printer.

Experience has taught us that if you deal with several graphics applications, you can never have too many conversion utilities. But also keep in mind that if you deal with several graphics applications, you can in many cases use them as glorified file converters. For instance, if you have products such as Aldus PhotoStyler, CorelDRAW!, Designer, and Picture Publisher lazing about somewhere on your hard disk, you should learn to take advantage of their many import and export filters for converting files for other applications. Many times they will work

as well—or even better than—a dedicated conversion utility.

THE CAPTURE CONUNDRUM

Whether capture or conversion is your biggest problem depends upon your working environment. Under Windows or OS/2 Presentation Manager, standard video drivers and a driver API combined with centralized memory management make capturing screens a snap; in fact, if you have problems with getting a screen capture under these two, chances are it's the result of a conflict with your driver.

With DOS, however, screen capture can be a nightmare. And unfortunately, it's the same nightmare that we've had for years. A DOS capture program must run as a TSR (terminate and stay resident) utility, and there's potential for conflict with any application that takes total control over the keyboard, protected-mode applications that use DOS extenders, or applications that simply require a lot of free RAM. So the ability to load into expanded or extended memory is a must for DOS users. This difficulty may account for the lack of activity in the DOS capture and conversion product market.

In addition, capture programs must be able to extract the screen image from the display memory that's on the graphic adapter. Under DOS, that means a capture program must have explicit driver support for a plethora of boards or, at the very least, commonly used graphics controller chips and BIOSes. Since VGA and VESA's Super VGA (800 by 600) specification are standards, these modes are fairly widely supported.

By comparison, capturing screens in a GUI environment seems like an embarrassment of riches. Not only is it easy, but the better programs offer a slew of area capture options; these include individual dialog boxes, drop-down menus only, icons only, and user-defined areas.

As the number of PC-based graphics applications grows, file format compatibility becomes a crucial issue: Most graphics programs are, after all, intended for generating images to be used by other applications. As the PC lumbers toward the ideal integrated working environment, at least we have a plethora of utilities to help pave the path.

Application Techniques Inc.

PictureEze with CaptureEze Pizazz Plus

BY CAROL ELLISON

Application Techniques has the DOS and Windows markets covered with PictureEze and Pizazz Plus. Pizazz Plus, the \$149 DOS entrant, packs file conversion, can be installed to run in Windows, and features a special utility to capture Windows screens. Its companion, PictureEze, a \$149 full-fledged Windows product, possesses all the capability of the DOS product, wrapped in a graphical interface. PictureEze's own screen capture

SUITABILITY TO TASK				
PictureEze with CaptureEze				
	POOR	FAIR	GOOD	EXCELLENT
Screen capture				
Raster file conversion				
Vector file conversion	N/A			
Image processing				
File management	N/A			

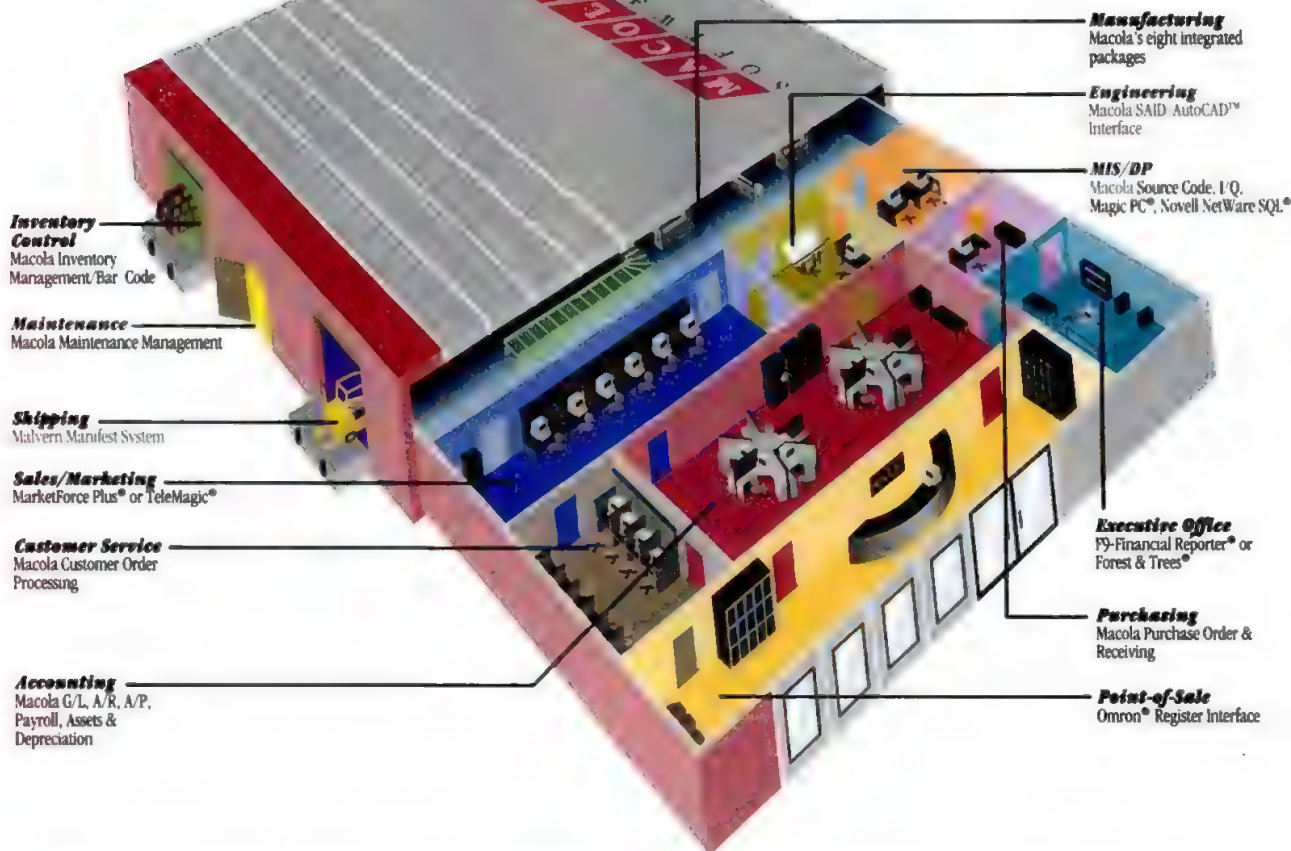
utility, CaptureEze, can also be purchased separately for \$59.

PictureEze and Pizazz Plus use the same file conversion algorithms, which allow users to convert raster files to standard formats, as well as to explicit specifications in a variety of flavors. And if you know nothing of file formats, but know you need to get a color file into CorelDRAW 3.0, you can choose an application from the save menu.

You can run both products under Windows, but when run in Windows, Pizazz Plus only lets you capture full-screen and client windows in the program's native PZI format. When run as a DOS app, though, this package lets you save directly to your selected format, just as PictureEze does.

Both products offer three methods of color reduction: match, which matches each color pixel to the nearest available color; dither, which mixes pixels to produce a perception of more colors; and diffuse, which smoothes color transitions in the dithering process. The default, dif-

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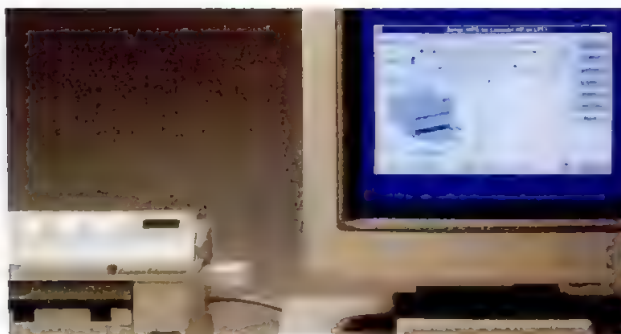


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■ Troubleshooting Conversions

by Jeff Mace

Graphics files fall into two general categories: raster, or bitmap files, and vector files. The two types of files vary greatly in how they describe an image and in how well they convert from one file format to another.

In the beginning, there were bitmap files, which stored pictures and the many attributes associated with them. The term *bitmap* arose as a means of describing a group of pixels, either black or white, that when put together and laid out according to a map created a picture. These 1-bit files could only describe simple black-and-white pictures, however. As hardware matured and color came on the scene, so did color images. It became more complex to describe these color and gray-scale pictures because a whole new set of problems came into being. Companies like Zsoft (which created .PCX) and NuVista (which created Targa) wrote specifications to help make these formats standards.

Of all the file formats, TIFF (Tagged Image File Format) is the most widely used because of its flexibility and cross-platform versatility. (For a more in-depth discussion, see "Looking at the TIFF Specification from the Inside" in the December 17, 1991, issue of *PC Magazine*).

Unlike bitmap graphic files, vector formats describe the objects and elements that make up the file. Converting vector artwork presents a challenge for graphics conversion applications, as the complexity with which these objects can be associated with one another is limited only by the creativity of the artist. To add to the confusion, when translating

objects, individually known as graphic draw primitives (GDPs), the application doing the job may not know where the file originally came from.

But that's the idea behind any interchange file format. These metafiles, which can carry both raster and vector information, are designed to travel. And

there are several graphics metafile formats around. The most popular are the Computer Graphics Metafile, commonly known as CGM, the Windows Metafile Format (WMF), and the GEM format from Digital Research. CGM files can include bitmap

information as a cell array or a GDP, and .WMF files can contain images as well. The Encapsulated PostScript format (EPS) can also be considered a metafile on one level, but it's also a programming language capable of much more. What all these metafile formats have in common is that they are known as "static" metafiles. Their data doesn't change; it's a single permanent record.

Understanding how file formats work does not make it any easier to make them do the things you want, however. Converting from one file format to another can be a daunting task. Here, we look at some of the most common problems you may run into and attempt to provide a few explanations and tips to help you navigate the wonderful world of file conversions.

Problem with vector file: Single objects or fills convert to multiple objects.

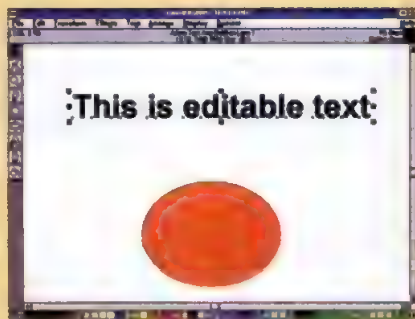
An easy way to spot this problem is to look at the size of your converted file. If it is vastly larger than the original, you can bet the conversion wasn't done effi-

ciently. The conversion is a three-step process: interpret the input file, figure out what you got, then write the output file. Vectors are a series of lines with points connecting them. High-level GDPs offer a sophisticated method of describing, or storing, vector information. Reducing each high-level GDP, even just a single red filled rectangle, to a series of vector points with coordinates will yield much more data than you started with. The best conversion filters translate the output file's definition for a rectangle, rather than convert it to vector points. Both ways work, but the former produces a much larger file.

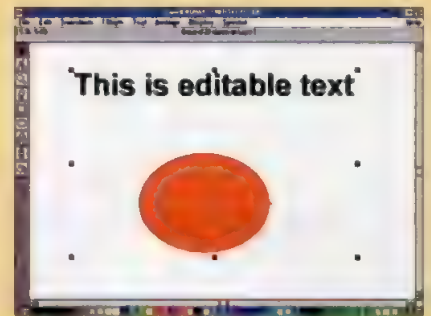
Solution: If the converted file is very large, break up its parts into separate pieces. Convert complex shapes to curves before you export the file.

Problem with vector and raster files: Text gets lost or loses its editability.

Each file format deals with text differently, as does each operating system or host application (.WMF is the exception here; since all Windows fonts are system resources, and .WMF is the file format of Windows, text interchangeability be-



Text created in a vector drawing program, such as CorelDRAW, is fully editable in its native format, even after you apply special effects.



That same text, after being converted to another file format, no longer exists as editable text; now it's just another part of the image.

tween applications is transparent). The file might find itself imported anywhere, on any platform, so the export filter should adjust for this. The safest way a metafile can define text is as a series of

polylines. When this is done, what was text is now a graphic element, no different than a polygon and no longer editable. If the text appears lost, it is probably still there, but as a graphic; it may have the wrong fill color or require a background color to illuminate it.

Solution: When exporting, keep the text in metafiles to a minimum if you require high-quality type. Polyines do not contain the fine font metrics intrinsic to type. Expect to edit the text manually, as it is probably no longer text as you knew it. To make text visible again, draw a rectangle and fill it with a dark color, then send it to the back. Use a file format like EPS if you need text, but be aware that the font you use must be resident on any machine that intends to import the file if the text is to display correctly.

Problem with vector files: Smooth shapes get jagged.

This can occur when GDPs are converted to polyines. If this conversion is done sloppily, a smooth arc can have too few or too many vector points. You may have used Bezier curves when creating the graphic, but if the target file format doesn't support them, they may get converted to polyines.

Solution: Convert all Bezier curves to polyines and hand edit them yourself to achieve smooth lines. If this is not an option and you're working in Windows, copy the graphic to the clipboard (to change it to .WMF), paste it into a new document, then do the save to the new format.

Problem with raster files: Your image appears pixellated or dithered.

If your full-color, 24-bit image no longer shows continuous tones, or the colors

look spotty, it is probably a case of user error. When you reduce the number of colors in an image, an application will try to compensate as best it can by dithering, or combining groups of dots in different patterns, to simulate the unavailable colors.



Full-color, 24-bit images like this one exhibit continuous tones, thanks to their palette of 16.8 million colors.

Solution: Be sure that you've chosen the appropriate color depth for your conversion. Also be sure that you're not just having a display problem. No conversion package can accurately display 24-bit

images if your video card only supports 8-bit color.

Problem with vector files: Elements of a file appear changed or rearranged. Extra "stuff" is visible in the file.

In sophisticated graphics that are made up of many elements, complex pathing and nested clipping regions may be used to describe the way a graphic is to be displayed. This information can be difficult to interpret, and it may tax an application that is attempting to do a conversion. Since "clipping to" a specified path is a way to create special effects, or treatments, any failure to interpret, or pass along, this information may "take away the mask," or undo the very trick used to bring about the desired result.

Solution: Carefully examine complex graphics after you convert them. Experimentation, though, is the key here. A hearty conversion filter can convert these files to a format such as CGM, but

an interchange format such as PostScript (which can handle complex pathing) will probably get the best results.

Problem with vector and raster files: Color shifts occur.

Colors are easy to describe if there is a 16-color palette, but harder if the palette is larger or contains true RGB information. There are different schemes to describe color info, and this tends to change as file formats like CGM and .WMF get updated. For example, a 256-color palette will contain an index that defines the individual colors. If the application reading the file interprets that information incorrectly, perhaps in reverse order, you will get the wrong colors in your graphic.

Solution: Contact your application's technical support department to obtain an updated version of their filter.

Problem with vector files: Line styles and widths change.

This is another example of a GDP being converted improperly to the corresponding primitive of the target file format, or of a poor conversion of a GDP to a polyline.

Solution: Try converting to a different file format acceptable by your target application.

Problem with raster files: Can't read file; program says "non-supported file type."

At some point,

you're likely to run into a file your program just can't open or attempts to open but reads improperly.

Solution: Send the file off to the developers of your graphics utility package. They will probably thank you for doing this with a patch code that will make it possible for the package to read the file. □



Convert that 24-bit image to an 8-bit file format, and your continuous tones will turn mottled and pixellated.

GRAPHICS
Conversion Utilities

► **S U M M A R Y O F F E A T U R E S**

Graphics Utilities



Products listed in alphabetical order

■ = YES □ = NO

Conversion Artist

DoDOT

FreezeFrame

HALO Desktop Imager

HiJaak

HiJaak for Windows

Screen Capture and Conversion

Capture areas:						
Full-screen	■	■	■	■	■	■
Active window	■	■	■	■	□	■
Client window	■	■	■	■	□	■
Window under mouse pointer	■	■	■	■	□	■
User-defined rectangle	■	■	■	■	■ (DOS apps only)	■
Freehand (nonrectangular)	□	■	■	□	□	□
Program icon	■	■	■	■	□	■
Icon caption	■	■	■	■	□	■
Capture full-screen DOS application	□	□	□	□	■	■
Capture protected-mode DOS application	□	□	□	□	■	■
Capture customizability:						
Any key or key combo can be assigned as a hotkey	■	□	□	■	■	■
Time-delayed capture	□	□	□	□	□	□
Capture file handling:						
Automatic writes to disk	■	■	■	■	■	■
Default capture file format	.DIB	None	.BMP	None	None	None
Number of file formats for capture	18	9	9	10	40	40
Incremental numbering	■	■	■	■	■	■
Automatic save to Windows Clipboard	■	■	■	□	N/A	■
Automatic printing option	□	■	■	□	□	■
Simultaneous print and save	■	■	■	□	□	■
Convert fonts to vectors or text	□	□	□	□	■	■ (DOS only)
Capture resolutions:						
Maximum resolution for capture	Limited by available memory	Any Windows resolution	1,024 x 768 x 16.8 million	Any Windows resolution	1,024 x 768 x 256	Any Windows resolution
Maximum color depth for capture	16.8 million	16.8 million	16.8 million	16.8 million	256	16.8 million

Image Processing

Number of zoom levels	None	15	15	8	None	Unlimited
Color reduction:						
To 16 gray levels	■	■	□	□	■	■
To 256 gray levels	■	■	□	■	■	■
To black and white	■	■	□	■	■	■
Place frame/mat border around screen	■ ■	□ □	□ □	■ ■	□ □	□ □
Load multiple images simultaneously	■	■	■	■	□	■
Each image window maintains own undo stack	■	■	□	■	N/A	■
Save color-palette information separately from the image file	□	■	□	□	■	■
Processing functions:						
Brightness/Contrast	□ □	■ ■	□ □	■ ■	■ ■	■ ■
Crop	■	■	□	■	■	■
Dither	■	■	□	□	■	■
Edge tracing	□	■	□	■	□	□
Flip/Mirror	■ ■	■ ■	□ □	■ ■	□ □	□ □
Gamma correction	□	■	□	■	□	■
Invert to negative image	■	■	□	■	■	■
Posterize	□	□	□	■	□	□
Rotate	■	■	□	■	■	■
Sharpening	□	□	□	■	□	□
Softening	□	□	□	■	□	□
Paint facility or image editor	■	□	□	■	□	■

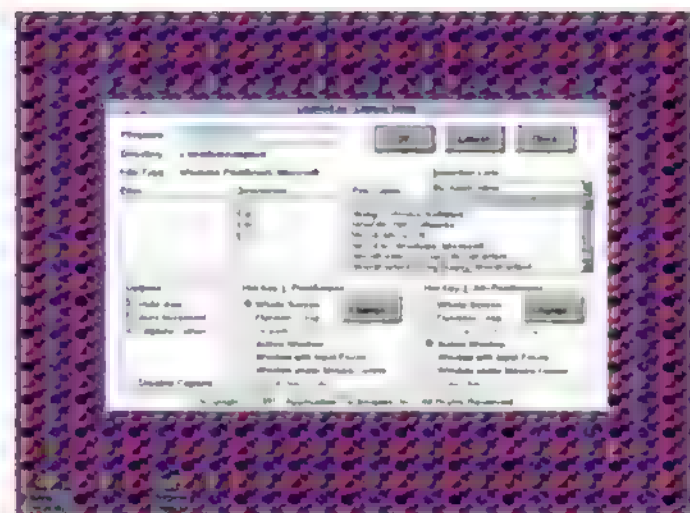
N/A—Not applicable The product does not have this feature

Conversion Utilities

CONTINUES

ImagePals	ImagePrep	Paint Shop Pro for Windows	PictureEze with CaptureEze	Pizazz Plus	Window Painters' SnapPRO!
☒	☒	☒	☒	☒	☒
☒	☒	☒	☒	☒	☒
☒	☒	☒	☒	☐	☒
☒	☐	☒	☒	☐	☒
☒	☒	☒	☒	☐	☒
☒	☐	☐	☐	☐	☐
☒	☒	☒	☒	☒	☐
☐	☐	☒	☐	☐	☐
☐	☐	☐	☒	☒	☒ (graphics only)
☐	☐	☐	☒	☒	☒
☒	☒	☐	☒	☒ (Windows only)	☐
☒	☒	☒	☐	☐	☐
☒	☐	☐	☒	☒	☐
None	.CPI	.BMP	None	.PZP	None
7	6	14	50	1	10
☒	☒	☒	☒	☒	☒
☒	☒	☐	☒	N/A	☐
☒	☐	☐	☐	☒	☐
☒	☐	☐	☐	☒	☐
☐	☐	☐	☐	☒	☐
Any Windows resolution	1,024 x 768 x 16.8 million	1,024 x 768 x 16.8 million	Any Windows resolution	Any Windows resolution	Any Windows resolution
16.8 million	16.8 million	16.8 million	16.8 million	16.8 million	16.8 million

15	None	18	7 plus user-defined	None	Unlimited
☒	☒	☒	☒	☒	☒
☒	☒	☒	☒	☒	☒
☒	☒	☒	☒	☒	☒
☒ ☒	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☒
☒	☐	☐	☐	☐	☒
☐	N/A	N/A	N/A	N/A	☐
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☒	☒	☒	☐	☐	☐
☒	☒	☒	☐	☐	☐
☒	☐	☒	☐	☐	☐



CaptureEze lets you choose your capture format either by specifying a file type or by specifying your target application.

fuse, produced the best results in the quickest time on our color reduction and gray-scale conversion tests. Dither is recommended only for CAD drawings and line art and match for charts with just a few colors and lines.

PICTUREEZE/CAPTUREEZE

In terms of interface and sheer ease of use, PictureEze bests its DOS companion by a mile. It installs as two icons: PictureEze, the conversion and image-editing component, and CaptureEze, the screen capture module. To perform screen captures, you simply specify filenames and formats in CaptureEze, and the program automatically increments the resulting files. Capturing a client area or just the window under a cursor is as easy as

SUITABILITY TO TASK

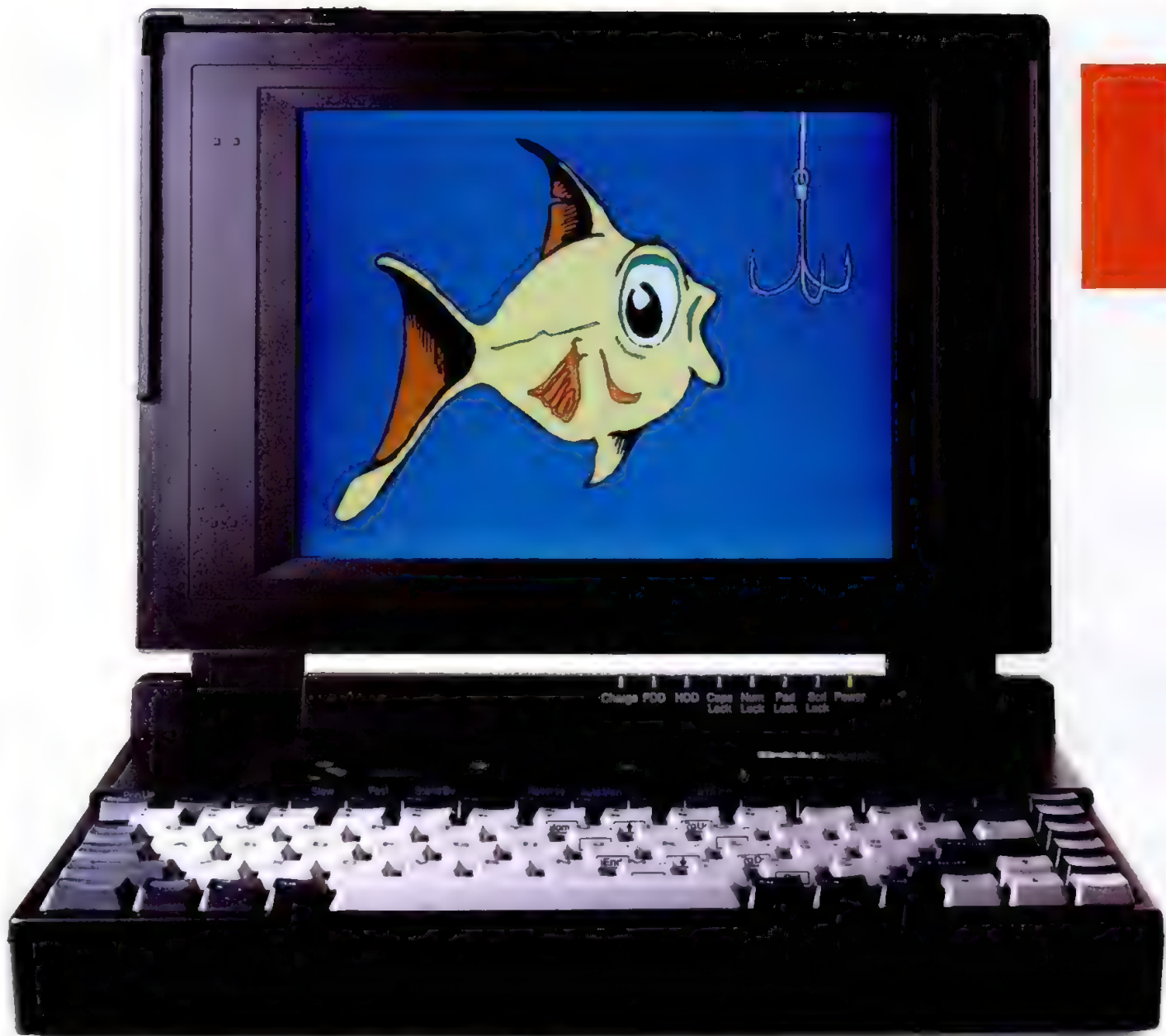
Pizazz Plus

	POOR	FAIR	GOOD	EXCELLENT
Screen capture	☒	☒	☒	☐
Raster file conversion	☒	☒	☒	☐
Vector file conversion	N/A			
Image processing	☒	☒	☒	☐
File management	N/A			

choosing from an options box and pressing Print Screen. If you are not happy with the capture key, you can choose another. The .BMP files that we captured in our performance tests were high quality and easily read in a variety of applications.

Cropping images with PictureEze is just as easy. Visual crop lets you drag borders of a frame to outline the area that you want to represent. Manual crop lets

OKAY. WHAT?



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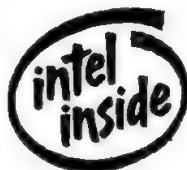
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GRAPHICS
Conversion Utilities

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO



**Conversion
Artist**

DoDOT

FreezeFrame

**HALO Desktop
Imager**

HiJaak



**HiJaak for
Windows**

File Conversion

Imports/Exports:

.BMP	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
.CGM	□ □	■ ■	■ ■	□ □	■ ■	■ ■
.CLP	■ ■	■ ■	■ ■	□ □	□ □	□ □
.CUT	■ □	□ □	□ □	■ ■	■ ■	■ ■
.DRW	□ □	□ □	□ □	□ □	■ ■	■ ■
.DXF	□ □	■ ■	□ □	□ □	■ ■	■ ■
.EPS	□ ■	■ ■	■ ■	□ □	□ ■	□ ■
FAX formats	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
GEM	□ □	■ ■	□ □	□ □	■ ■	■ ■
.GIF	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
HPGL	□ □	□ □	□ □	□ □	■ ■	■ ■
IFF (Amiga)	■ ■	□ □	□ □	□ □	■ ■	■ ■
.IMG	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
.JPG (JPEG)	■ ■	□ □	□ □	■ ■	□ □	□ □
Lossy compressed formats	■ ■ (JPEG, using optional module)	□ □	□ □	■ ■ (JPEG)	□ □	□ □
Macintosh formats	■ □	■ ■	■ ■	□ □	■ ■	■ ■
.PCX:						
Monochrome	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Gray-scale	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Color	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
PhotoCD (import only)	□	□	□	■	□	□
PM Metafile	□ □	□ □	□ □	□ □	■ ■	■ ■
RAS (Sun)	■ ■	■ ■	□ □	□ □	□ □	□ □
.TGA (Targa):						
16-bit	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
24-bit	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
32-bit	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
TIFF:						
Monochrome	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Gray-scale	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Color	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Compressed	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
.WMF	■ □	■ ■	■ ■	□ □	■ ■	■ ■
.WPG	■ ■	■ ■	■ □	□ □	■ ■	■ ■
Batch-convert a group of files	■	■	■	■	■	■

Output

Display full-screen image	□	□	□	■	□	■
Built-in screen show	■	□	□	□	□	□
Specify image size	■	■	■	■	■	■
Specify position of image on page	■	■	■	■	□	■
Specify number of copies	■	■	■	■	□	■
Specify draft resolution	□	■	■	■	□	■

Documentation and Support

On-line help	■	■	■	■	■	■
Toll-free technical support number	□	□	□	□	■	■
Technical support hours (eastern time)	10:00-5:00 M-F	2:00 P.M.-11:00 P.M. M-F	9:00 A.M.-9:00 P.M. M-F	9:00-5:00 M-F	9:00-5:00 M-F	9:00-5:00 M-F
BBS	CompuServe	Company-run, CompuServe, Internet, Prodigy	CompuServe	None	Company-run, CompuServe	Company-run, CompuServe

ENDS

[illegible]

FACT FILE

**PictureEze, Version 2.0, with
CaptureEze, Version 1.0**

List price: \$149; CaptureEze alone, \$59.

Requires: 286-based PC or better, 640K RAM, 2MB hard disk space, EGA display or better (VGA recommended), DOS 3.0 or later, Microsoft Windows 3.x, mouse

Pizazz Plus, Version 3.0

List price: \$149.

Requires: 8088-based PC or better, 40K RAM, 1MB hard disk space, CGA display or better (EGA recommended), DOS 3.0 or later.

In short: Both the Windows-based PictureEze and its DOS sibling Pizazz Plus offer a strong selection of file-conversion options. While PictureEze is easier to use, Pizazz Plus is more powerful; its overlay installation and its support for many explicit file formats make it a winner among DOS graphics utilities.

*Application Techniques Inc., 10 Lomar Dr.,
Pepperell, MA 01463; 508-433-5201;
fax, 508-422-8466*



ON READER SERVICE CARD

you set coordinates to identify the crop area.

With its stark text interface and command options, Pizazz Plus looks far less elegant than its Windows-based sibling. But don't let appearances fool you. It comes as a collection of modules with a conversion utility that must be loaded separately. Most notable is its support for more than 400 printers.

It cut our graphics conversion tasks down to size with a speedy batch facility that lets you easily tag and add names to the list of files you wish to convert. In addition, you can save these lists to further speed up the conversion process.

Screen captures require a TSR, which can be fully loaded or loaded as an overlay that calls the program. You can specify the overlay at installation to spare RAM or invoke it with a command line option. As an overlay, the capture module consumes only 40K, as compared with 160K for the full program.

Pizazz Plus lets you crop the images you're capturing by using arrow keys to adjust a frame identifying the capture area. If you want to crop and convert, however, you must specify the crop area

Conversion Utilities

by using numeric settings.

Given their similarities, it's not surprising that the products performed comparably on our tests. The only TIFF file they could not open was one saved to the new TIFF 6.0 specification, which neither package yet supports. There were a few other but not unexpected difficulties. Our 24-bit TIFF file also failed to open, an indication that the file header contains format information that the program doesn't recognize, according to Application Techniques. And our 16-bit TGA file produced a Windows applications error when we tried to open it in Picture-Eze; Pizazz Plus handled the conversion to .PCX beautifully, however. Both products also had some difficulty converting two of our 24-bit TIFF files to .PCX.

Both products offer an impressive number of conversion options, but Pizazz Plus is the more noteworthy. As one of the few DOS graphics utilities available, it stands out for its quick and easy file conversions, its outstanding printer support, and a Windows implementation that gets the job done on both fronts. If you're still working in a DOS world, don't miss it.

North Coast Software Inc.

Conversion Artist

BY CAROL ELLISON

Conversion Artist (\$149.95), from North Coast Software, tells no lies. It does what it claims to—file conversions, color reductions, screen captures, and image editing—with an elegance that really could be called artistry. It is so straightforward and easy to use that you'll hardly need to open the manual.

Simple format conversions are as easy as loading a file, clicking on Save As, and selecting the format and options you're outputting to. Conversion Artist displays the options available to you to produce specific flavors of the format—color or gray-scale; compressed or uncompressed; and monochrome, 16-

color, 256-color, and 16-, 24-, or 32-bit bitmaps—and grays out the options not available for that format.

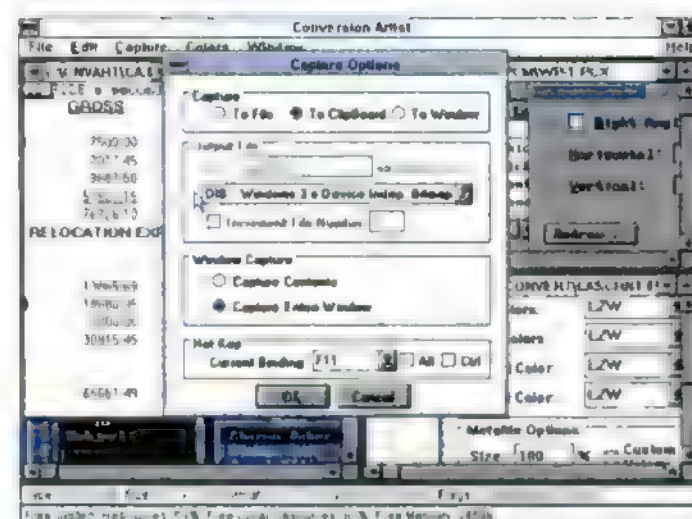
Color reductions are handled from Conversion Artist's Colors menu. As you select options on this menu, the program previews the effect on-screen. Color type, size, format, and flags are shown in a status line at the bottom of the screen. Once you're happy with the result, you simply save the file. The program features two methods of color reduction: Flat Cut, which uses a simple algorithm to distribute colors, and Optimized Cut, which creates a custom palette optimized for that image and produces better results.

For those who need to work with groups of files, Conversion Artist offers easy-to-use batch-processing capabilities. You simply point and shoot to select files for conversion, though you are limited to one pair of input and output file types per batch operation.

You have a variety of options when it comes to screen captures. You can choose from active application, active window, user-defined rectangle, entire screen, and window under mouse. From there, you can bring up a Settings option box to set more specific parameters such as whether you wish to capture just the contents of a window or capture to a file, a window, or the clipboard; your preferred hotkey, file format, and naming convention; and automatic incrementing. Conversion Artist can only directly capture DOS screens running in Windows, however. You can capture a full-screen DOS window, but the process is cumbersome, requiring you to first use Windows'

screen capture to capture it as a text screen, then bring it into Notebook and use Conversion to capture the contents of that window. You can, however, view multiple images and windows simultaneously.

Conversion Artist supplies a bare-bones complement of editing tools: Cut, Copy, Paste, and Delete. Image-editing tools sell as a \$69.95 option, as does support for JPEG compression (\$99.95);



Conversion Artist's screen capture lets you save the image to a file, a window, or the Windows clipboard, as well as specify capture area.

RGB to CMYK color separation (\$149.95); and support for the Dycam digital camera (\$5) and Kodak SV6600 printer (\$69.95).

A RASTER MASTER

Conversion Artist breezed through our raster file tests with nary a hitch, stumbling only on files that were predictably hard to handle: our TIFF 6.0 file (which none of its competitors could handle, either) and a couple of Windows Metafiles composed primarily of vector information.

Although it claims to handle files up to 16MB, users who routinely handle files of 12MB may want to look for another option. The program was unable to load

SUITABILITY TO TASK

Conversion Artist

	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	●
Raster file conversion	●	●	●	●
Vector file conversion	N/A			
Image processing	●	●	●	○
File management	N/A			

Conversion Artist, Version 1.1
 North Coast Software Inc., P.O. Box 459,
 Barrington, NH 03825; 603-664-7871;
 fax, 603-664-7872

List price: \$149.95.
Requires: 286-based PC or better, 2MB RAM, 1.2MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.x. Mouse or pointing device recommended.
In short: Bells and whistles such as image editing and JPEG conversions come as extras in North Coast Software's Conversion Artist, but this easy-to-use program can gracefully handle almost any raster file format you throw at it. In addition to its conversion capabilities, it offers a variety of options for screen captures, including active application, user-defined rectangle, entire screen, and window under mouse. And all of these options work just as well as the artistic conversions.

462 ON READER SERVICE CARD

our 14MB test file until we freed virtual memory space by deleting .Tmp files from our system. But it did prove able to convert more raster formats successfully, including those from non-PC platforms, than almost any other package.

If you're looking for a program to handle raster files with ease and elegance, look no further than Conversion Artist. It can handle almost anything you throw at it, with the exception of large files.

Halcyon Software Inc.

DoDOT

BY ERIC BERLIN

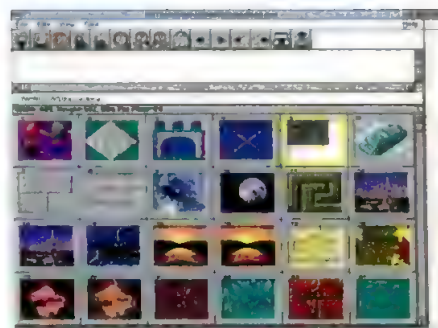
Halcyon Software has one of the leading reputations in the graphics utility field, and for good reason. Their product DoDOT (\$189) has a clean, intelligently designed interface, support for nearly every file format you'll need to use, and utilities for file management and image processing. The package consists of five modules: DoSNAP for image capture, DoCONVERT for batch conversions, DoVIEW for image viewing, DoDOT for image manipulations, and DoThumbnail for image management. Unfortunately, these modules work with only varying degrees of success.

DoDOT's handling of certain flavors

of TIFF is surprisingly poor, especially since all the other raster file formats converted and opened cleanly during our tests. In particular, the package had trouble with the 24-bit packbits and 256-color Motorola TIFF files in our test suite. DoDOT failed to read these files correctly, and it seemed blithely unaware of the problem, not sending any error messages to warn the user. Vector file formats fare even worse; its reading of CGM files is usually wildly inaccurate, converting dark backgrounds to light ones and cutting other images in half. When converting .WMF to EPS, no error messages appeared, but converted files would not open in DoVIEW. EPS to .WMF conversions, on the other hand, were perfect.

CAPTURED CLEANLY

Screen capture is as painless as can be, thanks to DoDOT's clean, simple Windows interface, which is consistent across all modules. Selecting windows to capture, or marking off a freehand area, is just a matter of clicking the right mouse button. You can perform full-screen, window, or DOS-app-in-a-window captures, as well as freehand captures. In addition,



DoDOT handles image management through its DoThumbnail module, which lets you attach annotations to thumbnails of your images.

the package has a true Multiple Document Interface, allowing you to display multiple images simultaneously. Our test captures all turned up clean and true to the originals, and they can be saved in a variety of formats.

DoCONVERT makes quick work of batch file conversions. This module can handle multiple file conversions between 50 different graphics file formats. You can choose multiple input and output file formats by just clicking on names in a list box. DoCONVERT then compiles the convert script, which you can save for fu-

▶ FACT FILE

DoDOT, Version 4.0

Halcyon Software Inc., 1590 La Pradera Dr.,
Campbell, CA 95008; 408-378-9898;
fax, 408-378-9935

List price: \$189

Requires: 286-based PC or better (386 recommended), 4MB RAM (8MB recommended), 4MB hard disk space, EGA display or better, DOS 3.3 or later, Microsoft Windows 3.x, mouse

In short: Weak handling of many file conversions offsets DoDOT's well-implemented capture and image editing capabilities. The DoThumbnail utility offers a convenient way to manage image files, and the package offers some strong color controls, particularly a color picker for adjusting hues, color mapping, and the ability to perform color separations in a choice of color models. But because of the product's lack of stable TIFF and vector file support, it is tough to recommend DoDOT



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SUITABILITY TO TASK				
DoDOT	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	○
Raster file conversion	●	●	●	○
Vector file conversion	●	○	○	○
Image processing	●	●	●	○
File management	●	○	○	○

ture use, and automatically does the rest.

DoDOT's image processing is strong on color control and separation; the helpful Color Picker tool makes adjusting the hues easy, and a color mapping option is highly customizable. This feature allows you to dither an image to monochrome using a choice of methods or to reduce or expand the number of colors in an image. In addition, the package allows you to perform color separations using either the RGB or CMYK color models. You can also save and edit an image's color palette.

Finding the brightness, contrast, and gamma controls requires a brief hunt through the menus, but then it's simply a matter of using the correct slider bar. Another set of slider bars, also accessible under the Adjust menu, allows you to adjust the levels of red, green, and blue in an image globally. DoDOT offers edge tracing, but only on the simplest of images; complicated color images come out either half-done or extremely messy. There are no sharpening or softening filters, though the next version, due in August, will include these and other image-manipulation tools.

Halcyon does not consider its Do-Thumbnail utility a file manager, and rightfully so; while it can create attractive thumbnails with a minimum of fuss, there's not much you can do with these images. Marking and deleting files is a matter of mouse clicking, and you can annotate images for later reference. Beyond that, all you can really do is send images to DoDOT's image processor or viewer.

DoDOT offers a Swiss Army knife approach to graphics utilities. Individually, the tools may not seem like much, but they add up to an attractive package. Just be aware of its weaknesses going in.

DeltaPoint Inc.

FreezeFrame

BY ERIC BERLIN

DeltaPoint, maker of FreezeFrame, Version 1.01, bought their core technology directly from Halcyon Software, creators of DoDOT, which is also reviewed here. The end result is a near cloning of DoDOT's smart interface. FreezeFrame, unfortunately, also clones all of the problems that DoDOT had, and DeltaPoint throws in a couple more as well.

FreezeFrame does not pretend to be the once and future graphics panacea. It offers no functions for editing images, it has no thumbnails or other file management capabilities, and its list of conversion formats does not extend much beyond the basics. But at \$89.95, FreezeFrame is acceptable for capturing and converting images.

Like DoDOT, this package is made up of separate modules linked by a common interface. Icon Editor can be used to cre-

ate icons, cursors, and bitmaps for Windows applications. FreezeFrame's Screen Capture module allows you to capture screens in a variety of ways. Viewers can display and print any graphics file that FreezeFrame supports, and Convert is a conversion utility with batch processing capability. However, unlike its doppelganger DoDOT, FreezeFrame has no image-processing module, so it can't handle any sort of color reductions or even simple image manipulations such as adjusting brightness or contrast.

It also falls short in its file conversions. In one instance, an unsupported file format message appeared when we tried to open a TIFF file that FreezeFrame had converted from 16-bit Targa without complaint. In

fact, the various types of TIFF files make FreezeFrame look positively amateurish. It had no problem handling some of them, including an exceptionally large 24-bit color file, but FreezeFrame simply could not read others, such as a 256-color Motorola file and a 24-bit Packbit compressed file.

Other files, such as our 8-bit and 4-bit color and 1-bit monochrome .PCX files converted to TIFF with no problem. However, FreezeFrame ran into another pothole with .CGM files, which the viewer module could not accurately read. Black turned to blue, and grey became white on a 3-D bar chart. Conversions to another vector file format brought no error messages, but brought no accurate

SUITABILITY TO TASK				
FreezeFrame	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	○
Raster file conversion	●	●	○	○
Vector file conversion	●	○	○	○
Image processing	N/A			
File management	N/A			

FACT FILE

FreezeFrame, Version 1.01

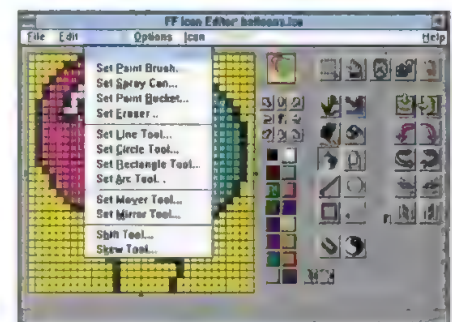
DeltaPoint Inc., 2 Harris Ct., Suite B1,
Monterey, CA 93940; 800-367-4334,
408-648-4000; fax, 408-648-4020

List price: \$89.95.

Requires: 286-based PC or better, 2MB RAM, 2MB to 13MB hard disk space, EGA display or better, DOS 4.01 or later, Microsoft Windows 3.x, mouse. 386-based PC, 4MB RAM, and VGA display recommended.

In short: Like DoDOT, which it shares a conversion engine with, this package boasts a clean, easy-to-navigate interface and a modular approach. Also like DoDOT, it suffers from conversion bugs and limited file format support that overshadow decent screen capture. Despite some bright spots—including an excellent icon editor and a selection of clip-art images and background bitmaps—it is hard to recommend DeltaPoint's FreezeFrame, Version 1.01, even at \$89.95.

ON READER SERVICE CARD



FreezeFrame offers more than just the standard screen capture and conversion abilities. In addition to these tools, it offers a customizable icon editor.

Conversion Utilities

reading, either. FreezeFrame did do a terrific job of converting the package's EPS clip art to .WMF format, though.

FreezeFrame does offer strong batch-processing capabilities, such as creating and saving conversion scripts and logs. You can convert a variety of file formats within the same conversion script, and you can follow along as the conversion log tracks the batch process. You can stop the batch operation at any time, and edit the conversion script as necessary.

BETTER AT CAPTURE

FreezeFrame fares much better with its screen capturing capabilities. You select a capture area or a hotkey combination by simply pressing the right mouse button. Hotkeys are limited to the function keys, but when joined with Shift, Ctrl, or both, there are more than enough key combinations.

DeltaPoint may not have included image editing abilities, but the company did see fit to include a Microsoft Windows icon editor that is not only easy to use but also remarkably flexible. It provides a generous supply of drawing, painting, and manipulation tools that allow you to easily create icons from scratch, or edit the icons supplied by other programs or the more than 50 icons and cursors that ship with FreezeFrame.

The icon editor is the only part of FreezeFrame that will make you forget that the version number is 1.01. But DeltaPoint has the makings of a fine product—if their conversion technology catches up with their ease of use.

Media Cybernetics

HALO Desktop Imager

BY ROCK MILLER

HALO Desktop Imager (\$169) has gotten even better since it won our last Editors' Choice award for graphics utilities. Its simple design and well-selected features hold up against the competition, making it an excellent tool for bitmap

conversions and simple image processing. The latest version, 2.0, keeps up with the times, adding support for JPEG and Photo CD formats, and including a Twain-compatible scanner interface.

This program's clean and deceptively simple interface makes it a natural choice for the novice user.

The only tools that are visible at first are well-labelled and attractive sliders for color, brightness, and gamma correction, and a few viewing tools (zoom, pan, and image frames). The rest of the tool box

is devoted to an icon panel for keeping multiple open images and windows in good order. If you need the palette window or the retouching tools, you can pop them up in floating windows; if not, they stay out of the way. The newly added gallery option, which lets you create thumbnail directories of your files and attach descriptive information to them, is very convenient for cataloging files (though it

SUITABILITY TO TASK				
HALO Desktop Imager				
	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	○
Raster file conversion	●	●	●	○
Vector file conversion	N/A			
Image processing	●	●	●	●
File management	●	●	○	○

FACT FILE

HALO Desktop Imager, Version 2.0

Media Cybernetics, 8484 Georgia Ave., Silver Springs, MD 20910; 301-495-3305; fax, 301-495-5964

List price: \$169

Requires: 286 based PC or better, 2MB RAM, 2MB to 15MB hard disk space, VGA display or better, DOS 3.2 or later, Microsoft Windows 3.x, mouse, 386-based PC, 3MB RAM, Super VGA display and 1MB printer RAM recommended

In short: Well designed, well implemented, and well priced, HALO Desktop Imager, from Media Cybernetics, is still an excellent addition to your Windows toolbox. Version 2.0 adds scanner support, support for JPEG and PhotoCD image formats, and a number of other improvements. The only drawback is a somewhat limited number of supported file formats.

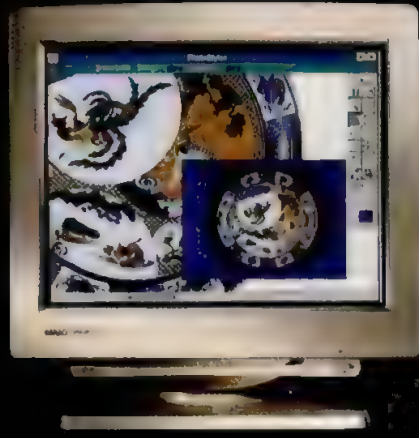
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would be nice to be able to search on the text). HALO's screen-capture function, which can be invoked within the program or as a separate module, is equally simple and well designed.

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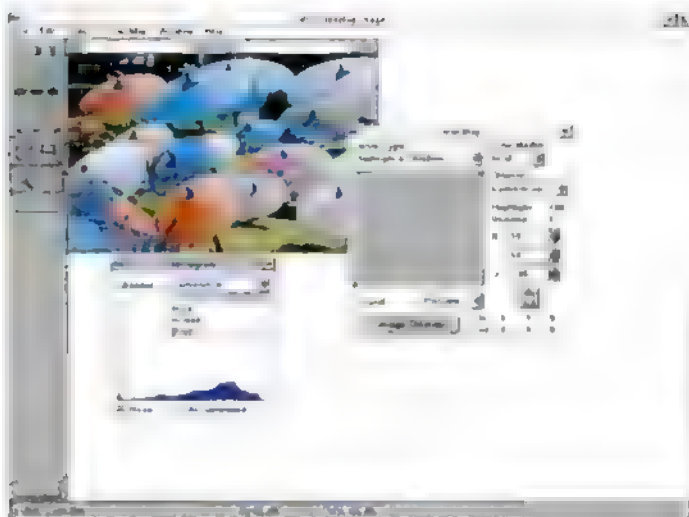
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Conversion Utilities



HALO Desktop Imager packs a lot of image processing power. Advanced users will appreciate the detailed control over color maps and histograms.

HALO's file conversions are adequate, if not lavish in their options. The program supports the most common flavors of major bitmap formats, with optimized color reduction and gray-scale conversion available through a simple dialog box. Unlike some competitors, HALO pays careful attention to the details of black-and-white halftoning for laser printing: You can select from a variety of fixed halftone screen angles and densities. But color dithering is not supported.

IMPERFECT CONVERSIONS

The actual conversions had a few problems. Our three-plane color .PCX test image came into HALO gray-scaled, and some sizing and color conversion problems arose in converting .PCX and JPEG images to TIFF. Color reduction on our 13MB true-color TIFF image left an artifact, in the form of a line of black pixels. HALO's batch conversion function could also use some improvement: Some options (such as JPEG compression ratios) can't be set in batch mode, and the input and output directories are not retained separately by the program, forcing you to specify the directories repeatedly when doing multiple batch conversions.

In spite of its simple design, HALO Desktop Imager packs a lot of image processing power, going far beyond the usual controls into special effects territory occupied by costly image editors. It supports softening, sharpening, and despeckling filters, and its special effects include embossing, posterization, pixellation, edge tracing, and photographic negatives. All of these effects can be performed within a rectangular frame as well as on the entire image; the frame is also

used for cropping and matting operations. This excellent design makes it easy to perform a number of processing options at once before cropping, and lets you change the crop area as you go.

You can paste and merge separately scanned images together. A pop-up panel gives you a choice of pen, brush, airbrush, texture, and eraser tools; you can also add text using TrueType fonts. Advanced users will appreciate the detailed control over color maps and histograms, scanner and printer calibration and test strips, and color separation functions.

Powerful image-processing functions, acceptable captures and conversions and an exceptionally slick interface set HALO apart from the competition.

Inset Systems Inc.

HiJaak

HiJaak for Windows

BY ROCK MILLER

Two different products, one powerful conversion engine, is the easiest way to describe these offerings from Inset Sys-

tems. Though they differ in interface and some features, HiJaak and HiJaak for Windows (both \$249) share the most extensive set of raster and vector conversions on the market.

SUITABILITY TO TASK

HiJaak for Windows

	POOR	FAIR	GOOD	EXCELLENT
Screen capture	☒	☒	☒	☒
Raster file conversion	☒	☒	☒	☐
Vector file conversion	☒	☒	☒	☐
Image processing	☒	☒	☒	☐
File management	N/A			

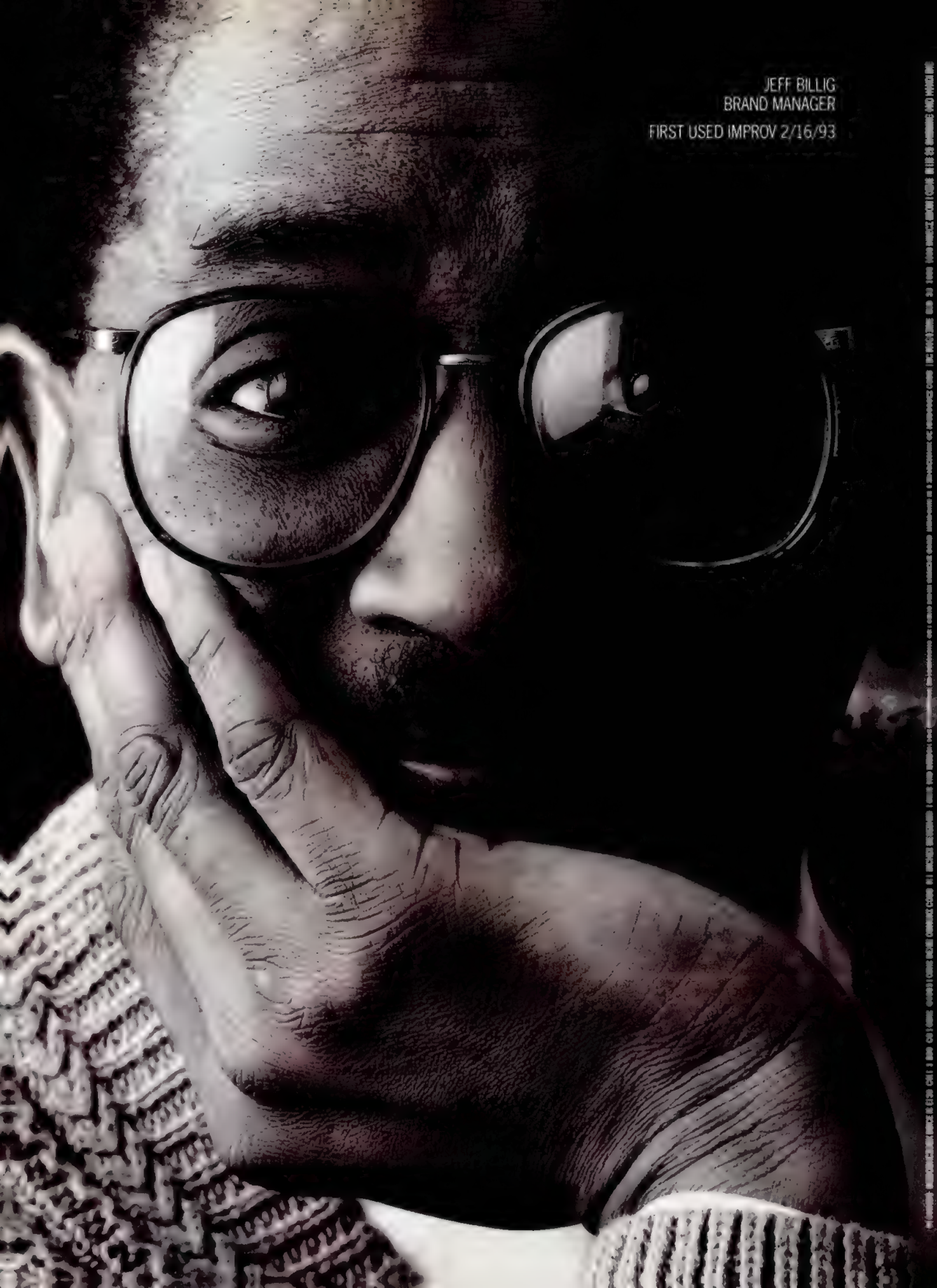
The scope of these programs is encyclopedic. They can read and write all the common bitmap and vector formats (with the exception of EPS, which they can write but not read), plus many others, from the uncommon to the downright unusual, including Amiga .IFF, AutoCAD .DXF, Defense Department CALS raster format, HPGL, and IBM GOCAS. Both Hijaaks can convert bitmap or vector files into the proprietary formats of 24 different fax boards, and they can even trans-

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This screenshot shows a dynamic view of a spreadsheet organized by product. The interface includes a sidebar on the left with category tiles, a main data area with columns for 'This Year', 'Next Year', and 'Total', and a bottom status bar.

Category	This Year	Next Year	Total
Cost of Goods	9,635	10,366	19,999
Revenue	5,204	5,811	11,015
Profit	4,332	4,795	9,127
Margin	1,493	1,775	3,268
Total	2,829	2,879	5,708

DYNAMIC VIEWS IN ACTION. VIEW 1 IS A SPREADSHEET BY PRODUCT (FOR BRAND MANAGER).

This screenshot shows a dynamic view of a spreadsheet organized by line item. The interface is similar to the first view but with different category tiles and data columns.

Category	This Year	Next Year	Total
Cost of Goods	9,635	10,366	19,999
Revenue	5,204	5,811	11,015
Profit	4,332	4,795	9,127
Margin	1,493	1,775	3,268
Total	2,829	2,879	5,708

JUST DRAG AND DROP AND IMPROV INSTANTLY BUILDS VIEW 2, BY LINE ITEM (FOR VP OF MARKETING).

This screenshot shows a dynamic view of a spreadsheet organized by region. The interface displays a different set of category tiles and data columns.

Category	This Year	Next Year	Total
Cost of Goods	9,635	10,366	19,999
Revenue	5,204	5,811	11,015
Profit	4,332	4,795	9,127
Margin	1,493	1,775	3,268
Total	2,829	2,879	5,708

DRAG AND DROP AGAIN AND YOU GET VIEW 3, BY REGION (FOR CORPORATE PLANNER).

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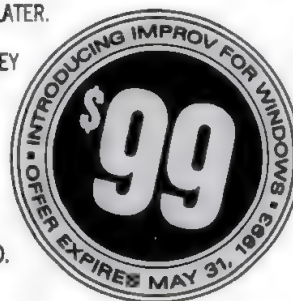
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Conversion Utilities

late PCL4 print files from your HP LaserJet driver for conversion into bitmapped images, soft fonts included. Notably missing from this version is support for lossy compressed formats such as JPEG, but this option should be available in HiJaak for Windows, Version 2.0, soon after you read this.

The HiJaak programs are equally remarkable for their support of the myriad flavors of the protean CGM and TIFF formats. You can bitmap files explicitly into all variations of monochrome, gray-scale, palette-based color, and true-color TIFF (up to version 5.0), including all TIFF compression standards. There's even a utility called ScanTIFF that can read and duplicate the parameters of any oddball TIFF file. The range of CGM flavors is equally comprehensive: You simply select the name of the application into

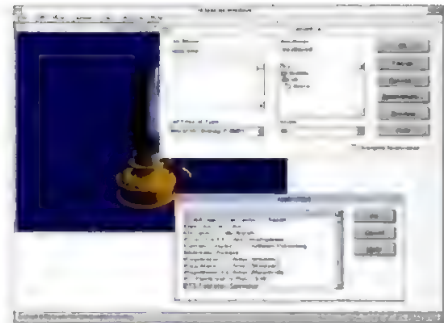
which you intend to import the file. EPS output is fully editable, and you can even convert some uncommon flavors of WMF files.

Both HiJaak and HiJaak for Windows share a set of common output and input options. You can explicitly select any

number of bits or bit planes supported by the format and flavor in question. You can reduce to 4, 16, 64, or 256 gray scales, and you can color-reduce images by dithering or color halftoning, as well as by means of opti-

mized palettes. You can select the halftone screen (angled only) for monochrome output, and choose dither and error-diffusion options.

HiJaak for Windows offers a graphical environment that lets you open multiple files and see the results of image processing and cropping on the screen. By con-



HiJaak for Windows lets you select the target application you want to convert a file to.

trast, the DOS version of HiJaak takes a "black box" approach, offering no way to view your files.

BETTER BATCH CONVERSIONS

While the Windows version lets you do batch conversions with files of the same type, the DOS version of HiJaak lets you take files of different types and directories and convert them to a single output type, making it a better choice for batch conversions. Its windowed text-mode interface is confusing, but proves powerful

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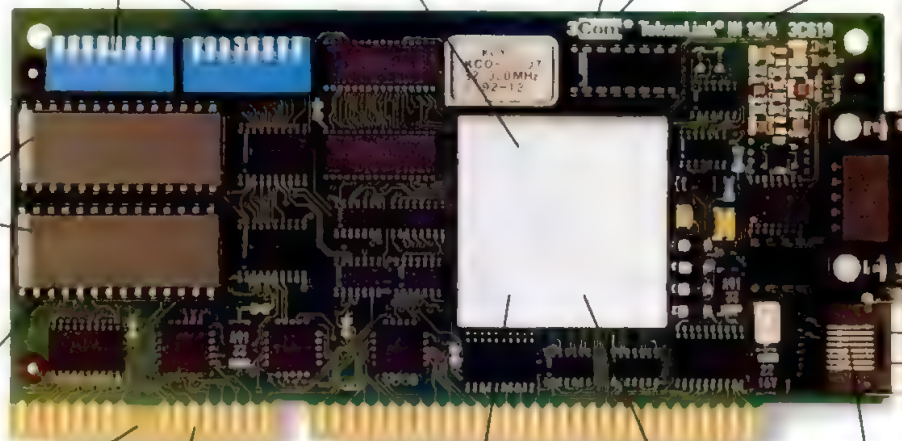
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▶ FACT FILE

HiJaak, Version 2.1

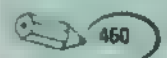
**HiJaak for Windows,
Version 1.0**

*Inset Systems Inc., 71 Commerce Dr.,
Brookfield, CT 06804-3405; 800-374-
6738, 203-740-2400; fax, 203-775-5634*

List price: \$249 each

Requires: HiJaak: 8088-based PC or better, 470K RAM, 3.5MB hard disk space, MDA display or better. DOS 3.0 or later. HiJaak for Windows: 286-based PC or better, 2MB RAM, 5.5MB hard disk space, VGA display or better. DOS 3.0 or later. Microsoft Windows 3.x

In short: Though their image processing abilities range from the merely adequate to the nonexistent, HiJaak and HiJaak for Windows are unbeatable for the sheer breadth of their conversions and conversion options. The Windows version is easier to use, but the DOS version is worth consideration, especially if you do a lot of batch conversions.



once you get used to it. You can also do conversions by using command-line switches, an option that lets you use alternative palette optimizations not available from the menus.

Another advantage of the DOS version is its ability to substitute a limited range of text fonts in vector conversions. HiJaak's vector conversions keep text in editable form, a major advantage, but in the DOS version you can scan any vector file for the named fonts and map them to HiJaak's own set of basic fonts for output. In HiJaak for Windows, you can remap fonts to TrueType or "train" the program to remap to other application fonts, such as AutoCAD fonts.

Both packages can snap DOS and Windows screens, but HiJaak for Windows has a full-featured Windows screen-capture module that lets you select windows or areas, and simultaneously direct the output to the clipboard, the printer, or a file. The simpler module in HiJaak for DOS simply snaps the entire Windows screen. Unfortunately, this utility produces files only in Inset's proprietary

format. It also caused palette problems when we tried to snap the graphical display of Lotus 1-2-3's WYSIWYG mode.

As might be expected from such an ambitious package, some HiJaak conversions work better than others. In our tests, bitmap conversions went smoothly, marred only by occasional confusions in setting output options for color and gray-scale reduction.

Vector conversions were about as good as could be expected. Smooth conversions were possible on simple images such as bar and line charts, and also on our astronaut image, which is composed of shapes. Our battery of CGM test images, however, revealed a host of problems, ranging from errors in line weight, line style, and text size, to clipping problems. To be fair, we should mention that many of these problems could be fixed in a graphics editor.

For sheer ambition, it's hard to top HiJaak and HiJaak for Windows. Their ability to handle raster, vector, and more unusual file types makes them worth considering.

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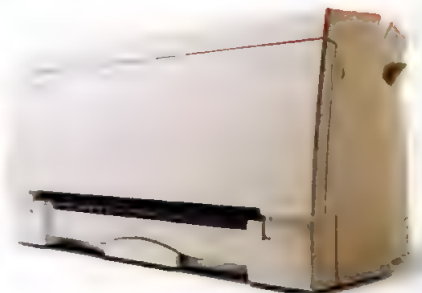
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U-Lead Systems Inc.

ImagePals

BY GARY BERLINE

Working with ImagePals, Version 1.0, from U-Lead Systems Inc., feels like slipping into a pair of comfortable shoes. The nearly seamless interface, which uses a picture album metaphor, combines with support for the most popular bitmap image formats, solid screen captures, and impressive image management and manipulation abilities to make this \$249 package a versatile all-around image athlete.

ImagePals delivers its functions in three separate but tightly integrated modules—Album, Capture, and Enhancer. Album serves as both the image manager and, with the aid of an easily configured tear-off toolbar, as the command center from which you can launch other modules or entirely unrelated applications. You can install programs into the toolbar using drag-and-drop, and you can launch them with the image of your choice already loaded—one of the many conveniences wrapped up in this bundle.

SUITABILITY TO TASK				
ImagePals				
	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	●
Raster file conversion	●	●	●	○
Vector file conversion	N/A			
Image processing	●	●	○	○
File management	●	●	●	○

Album lets you organize your images in photo-album fashion, making it simple to find and view them. You place images in an album by importing all those found on a given path or by selecting them from a scrolling list. Each album has its own configuration, displaying either image thumbnails or filenames. Filename lists can be sorted by any one attribute, such as file extension, size, date, the image's description (which you write), its data type, resolution, dimension, or its user-assigned label. Labels let you instantly

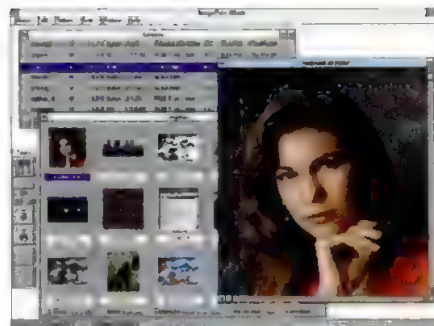
jump to a specific image. A point-and-shoot dialog allows easy but powerful logical searches based on any combination of attributes such as filename (followed by an optional "not" operator), description, size range, and

more. Many file-related functions also give the option of browsing the disk using an excellent cross-directory scanner.

Plenty of other conveniences make short work of tasks such as archiving images to floppy disk, deleting them from albums, removing their corresponding files, and viewing information about them. You can apply most commands to multiple albums via an album manager.

SPLIT DECISION

Somewhat confusingly, ImagePals splits conversion routines between Album—which offers an adequate but unspectacular array of format translations including .BMP, .GIF, .JPG, .PCX, .TGA, and TIFF—and Enhancer, where you'll find a decent selection of color reductions. The software doesn't handle Packbits compression and lacks support for any vector formats. A release in beta at the moment—due out by the time you read this—adds some vector capabilities and support for Kodak's Photo CD format, and makes the product an OLE server and client. The software performed flawlessly on tests of its supported formats, with the exception of a single .TGA file, which it could not open. The beta copy of the program successfully converted this file. Printing proved effortless.



ImagePals offers a flexible image management system based on a photo album metaphor.

Enhancer supplies better-than-basic image-editing tools, but is really meant for simple tasks. Still, a stitching routine makes hand-scanning almost bearable and the product supports a good number of scanners with the help of a Twain driver. Although Capture doesn't work on DOS screens, it ranks with the best of its ilk, allowing you to add effects to screen captures, and pinpoint a capture area using a click-and-drag rectangle.

ImagePals empowers users who need industrial-strength image management but can get along with reasonable format conversion and basic image-editing tools.

HSC Software Inc.

ImagePrep

BY TOM AMOROSO

HSC Software is no stranger to the graphics software market, and this is evident in its \$99 graphics utility package, ImagePrep, Version 4.0. ImagePrep offers strong screen-capture and color-manipulation features, but falls short in its file-conversion capabilities, limiting the user to only raster conversions and offering no batch conversion tools.

ImagePrep's interface will look famil-

SUITABILITY TO TASK				
ImagePrep				
	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	○
Raster file conversion	●	●	○	○
Vector file conversion	N/A			
Image processing	●	●	●	○
File management	N/A			

FACT FILE

ImagePals, Version 1.0
 U-Lead Systems Inc., 970 W. 190th St., #520,
 Torrance, CA 90502; 310-523-9393;
 fax, 310-523-9399

List price: \$249
Requires: 286-based PC or better, 2MB RAM, 8MB hard disk space, EGA display or better, DOS 3.0 or later, Microsoft Windows 3.x. 386SX-based PC, 4MB RAM, 15MB hard disk space, and Super VGA display recommended
In short: A comfortable interface, well-implemented file management, and excellent screen capture make ImagePals almost a bargain. Its few shortcomings—such as limited format support—should be eliminated in the new version, expected soon.

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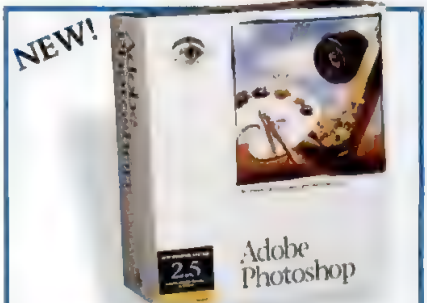
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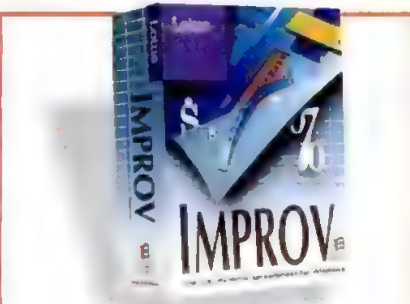
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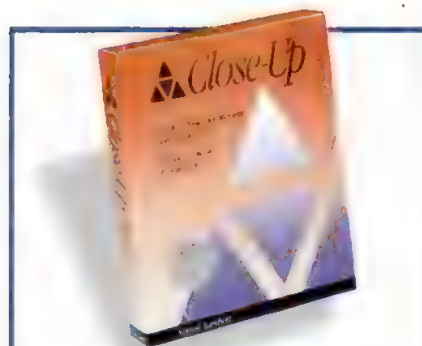
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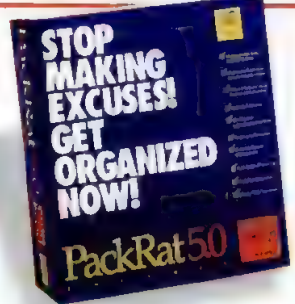
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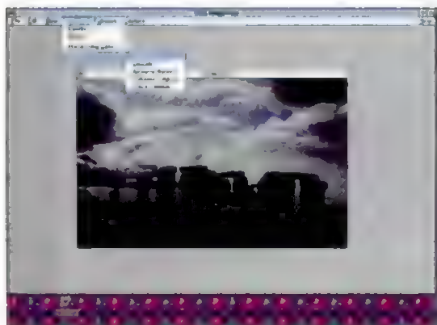
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ImagePrep offers some interesting extras in the way of image-processing tools.

iar to any Microsoft Windows user. Commands are accessible from pull-down menus, most of which are no more than two levels deep. The title bar offers a straightforward entry into the package, with command-line options for each major facet of the package, including Capture, Enhance, and Process, as well as Standard File, and Edit sections.

Within the Edit menu lies the Merge command. This allows the user either to stitch together two halves of a large image scanned in with a hand scanner, or to create collage-like effects by stitching unrelated images together.

FLEXIBLE CAPTURES

ImagePrep's screen-capture capabilities are both flexible and capable. The pack-

age offers a host of options for capturing, including user-definable capture areas, full window capture, client window capture, and icon capture. All of these choices are easy to make, thanks to the simple pull-down command bars. You can save screen captures using an array of file formats, including a proprietary format, called CPI. Although not supported by many other software packages, the CPI format offers proprietary image compression.

When one of our tests called for a full screen capture with multiple Windows applications and a DOS window running simultaneously, ImagePrep handled the task without difficulty. The resulting conversion was true to the original, displaying no artifacts when opened in Micrografx's Picture Publisher.

File conversion is ImagePrep's main downfall, however. Our tests called for the package to open and convert a wide variety of TIFF file flavors. Unfortunately, ImagePrep could only open the noncompressed TIFF formats. It failed to open our 256-color Motorola Packbits compressed file, as well as 24-bit Packbits compressed and LZW compressed files. The uncompressed TIFF files that ImagePrep successfully opened converted cleanly, however. Although the package had no problem opening and converting our Targa files, it did have some difficulty in reading a three-plane, eight-bit, color .PCX file. ImagePrep handled our other .PCX file conversions without difficulty, though.

Where ImagePrep excels is in the extras it offers. You'll find the standard fare here, including color reduction from 24 to 4 bit and from color to grayscale or black and white, as well as brightness and contrast, balance, and gamma control. In addition, you'll find several less-standard offerings, such as sharpen, blur, smooth, and noise reduction filters. All ImagePrep lacks in the way of image editing tools are zoom/pan commands and basic drawing tools.

If your graphic-utility needs include extensive file-conversion capabilities, the ImagePrep package falls short. But, considering its strong image-manipulation tools, ease of use and its relatively low price, ImagePrep may well be worth the investment.

JASC Inc.

Paint Shop Pro for Windows

BY JOSEPH DESPOSITO

As an image processing tool alone, Paint Shop Pro for Windows from JASC Inc. offers enough features to justify its very reasonable \$49 price. Add to this a capable screen-capture utility and support for a bevy of bitmapped file formats (though no support for vector-to-vector file conversions), and you have a true bargain. The program is strictly for Microsoft Windows, though, and does not capture DOS screens. For DOS capture, you'll need to add the \$39 Professional Capture Systems.

There are two versions of Paint Shop Pro, one shareware and one registered. The shareware version is available on ZiffNet in the Public Brand software forum as PSPRO.ZIP. The registered version of the product, which includes a printed manual, is available direct from the company.

Paint Shop Pro follows the standard Windows interface, using traditional pull-down menus, icons, and scrolling lists. You may work on only one image at a time, but any time you open an image file, the size of the image in pixels and

SUITABILITY TO TASK	
Paint Shop Pro for Windows	
Screen capture	● ● ● ● ○
Raster file conversion	● ● ● ● ○
Vector file conversion	N/A
Image processing	● ● ● ● ●
File management	N/A

the color depth of the image are displayed in the title bar.

Paint Shop Pro really shines when it comes to image processing. For example, you can apply a wide array of standard filters to 24-bit images to sharpen, soften, blur, or otherwise vary the entire image. Additionally, you can create customized convolution filters simply by changing numbers in a filter matrix. Changing the numbers changes the values of corresponding pixels. This is helpful when you

FACT FILE

ImagePrep, Version 4.0
HSC Software Inc., 1661 Lincoln Blvd.,
#101, Santa Monica, CA 90404;
310-392-8441; fax, 310-392-6015

List price: \$99
Requires: 286-based PC or better, 2MB RAM, 1MB hard disk space, VGA display or better, DOS 3.0 or later, Microsoft Windows 3.x, mouse
In short: This old standby from HSC Software is strong on screen capture, versatile on image editing, and weak on file conversions. It can handle only uncompressed file formats, and its TIFF and WMF support is limited. It's easy to use, though, and adept at color reductions. Its image-editing tools include balance and gamma control, as well as a smattering of filters. If all you are interested in is working with the more common raster file types, and you do not need batch processing, ImagePrep may just fill the bill.

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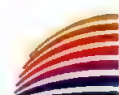


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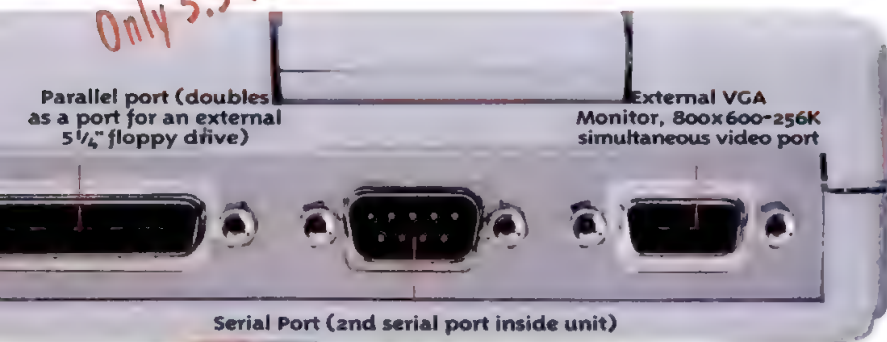
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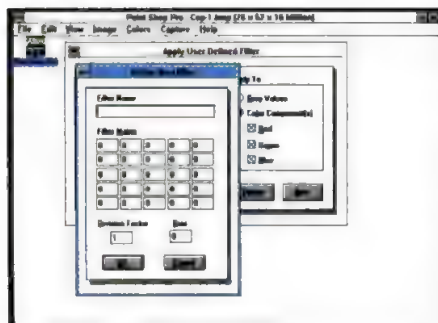


PCM0432

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CIRCLE 132 ON READER SERVICE CARD

Conversion Utilities



Paint Shop Pro for Windows lets you define your own image filter by entering numbers into a matrix.

want to accomplish tasks that are not possible with the Standard filters. Paint Shop Pro also does a fine job with image conversions. It not only supports a wide assortment of bitmap file formats, but also supports different variations within the format. For example, Paint Shop Pro supports two versions of .PCX files and three versions of TIFF files. The program offers no batch capabilities, however.

Screen captures are done from the menus or with predefined hotkeys. You may capture full screens and active windows or specify an area of the screen with the mouse. In our testing, Paint Shop Pro's screen capture capabilities proved adequate, with all captures looking like their originals.

The current version of Paint Shop Pro does not support JPEG compression, but it does offer JAS, a proprietary compression format for 24-bit color and 8-bit

gray-scale images. Paint Shop Pro also reads and saves files in other compressed formats, such as Huffman and LZW.

NOT PERFECT

Although Paint Shop Pro supports many kinds of file formats, the program is not flawless in this respect: It had trouble opening three of the ten TIFF test files. In each case, Paint Shop Pro provided a reasonable error message. However, the files that the program managed to open correctly looked perfect. We also had trouble reducing a 24-bit true-color TIFF file to 8-bit color. An error message noted that not enough contiguous memory was available on the system, and this problem could not be overcome.

Paint Shop Pro is a sophisticated product that is simple to use. At the low price of \$49, it offers more than enough in the way of image-processing and file-conversion utilities to make it a worthwhile investment. You should keep in mind, however, that Paint Shop Pro does not support vector-to-vector image conversions.

Window Painters Ltd.

Window Painters' SnapPRO!

BY JOSEPH DESPOSITO

Window Painters' SnapPRO! might belong in your graphics arsenal, but you wouldn't want it to be your only weapon. It captures Windows screens with ease and performs file conversion and image processing through an appealing interface. But an inability to decode compressed TIFF files is a glaring weakness of this \$69.95 screen capture program from Window Painters.

SnapPRO!'s interface is a beauty. It foregoes the traditional Windows pull-down menus and instead uses buttons and check boxes to do its work. When you open a graphics file, you immediately see a thumbnail view and check marks next to the file format and palette type of the image. To do a file conversion, you simply

check the appropriate file format box and then hit the save button. To perform a task such as reducing the palette from 16.8 million to 256 colors, you simply check the appropriate palette type box. The thumbnail view immediately changes to show you the new image.

SnapPRO! does a fine job of capturing and displaying images. Most of the images captured during testing did not display well in applications such as Picture Publisher, but they printed out correctly. This presents a serious problem if you're

trying to develop on-screen applications. Image conversion is essentially limited to converting from one bitmapped format to another, but SnapPRO! can rasterize .WMF—that is, it extracts only the bitmap information from this format.

Image processing is rather limited, with features such as brightness, contrast, and gamma correction missing from the program. When you select Toolbox on the opening menu, the Image Builder appears. This is where you can create effects such as flip, rotate 90 degrees, mirror, and so forth. An interesting feature of the Image Builder, called Mask, turns all external white spaces transparent, allowing underlying images to show through, which in some cases makes the two images look like one. Another feature, Transparent, lets you see other images through the selected image.

Another nice feature, which appears on the opening menu, is called Wallpaper. Selecting this option lets you add

SUITABILITY TO TASK				
Window Painters' SnapPRO!				
	POOR	FAIR	GOOD	EXCELLENT
Screen capture	●	●	●	○
Raster file conversion	●	●	○	○
Vector file conversion	N/A			
Image processing	●	●	●	○
File management	N/A			

FACT FILE

Paint Shop Pro for Windows, Version 1.02

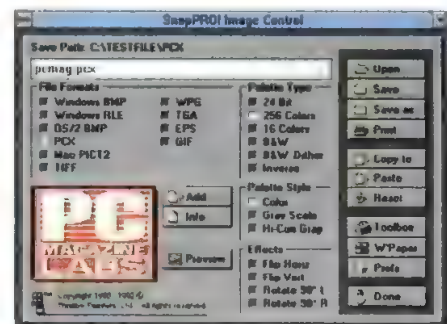
JASC Inc., 10901 Red Circle Dr., #340, Minnetonka, MN 55343; 612-930-9171; fax, 612-930-9172

List price: \$49

Requires: 286-based PC or better (386 recommended), 2MB RAM (4MB recommended), 550K hard disk space, VGA display or better, DOS 3.1 or later, Windows 3.x.

In short: Though not the most powerful product, Paint Shop Pro for Windows handles a long list of bitmap file conversions with ease. That—along with a straightforward interface, above-average screen capture, and the lowest price here—makes it a worthwhile choice for basic captures and conversions.

ON READER SERVICE CARD



In Window Painters' SnapPRO!, when you open a file, you see its format and palette type boxes checked.

Conversion Utilities

an image directly into your desktop to create custom Windows wallpaper.

NOT WITHOUT PROBLEMS

SnapPRO! is generally easy to use, but it is not obvious at first how to do screen captures, since there is no command for this. You need to stumble into the preferences menu (or read the manual) to realize how to set the hotkeys for full and partial screen captures. When you install the program, dual icons appear in Windows; one is for launching the main menu screen, and the other is for capturing rectangular screen areas of any size. As for file conversion, SnapPRO!'s inability to display compressed TIFF files is a nuisance. SnapPRO! is so ill-equipped to handle these files that a general protection fault error sometimes results and the program shuts down. In addition, the program lacks batch-processing capabilities.

Window Painters expects to release a new version of its product in April 1993. This version will address the issue of compressed TIFF files and add such features as a thumbnail gallery and a screen show.

At the reasonable price of \$69.95, SnapPRO! offers enough in the way of usability and features to make it a worthwhile addition to your graphics utilities toolbox. But if you need a utility to do vector-image-to-vector-image conversion, or if you often work with compressed TIFF files, then SnapPRO! is definitely not for you. □

FACT FILE

Window Painters' SnapPRO!, Version 2.03

Window Painters Ltd., 9301 Bryant Ave. South, #201C, Bloomington, MN 55420; 612-881-7576; fax, 612-881-5096

List price: \$69.95

Requires: 286-based PC or better, 1MB RAM, 2MB hard disk space, VGA display or better, DOS 3.1 or later, Microsoft Windows 3.1, mouse 386/33-based PC, 4MB RAM, and Super VGA display recommended

In short: It offers an appealing interface and terrific screen captures, but you'll have to wait for the next version for vector and compressed TIFF file support. Window Painters' SnapPRO! is worth considering for easy captures and basic conversions at a low price

 ON READER SERVICE CARD

Save Disk Space



PKZIP version 2.0

PC WORLD



WORLD CLASS
AWARD

"PKZIP is the undisputed champion of data compression" - BYTE Magazine

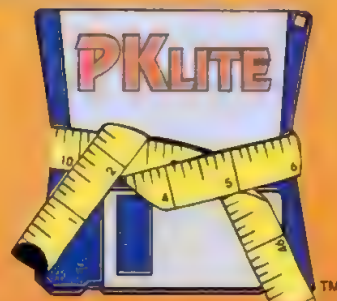
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PC-4/93

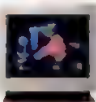
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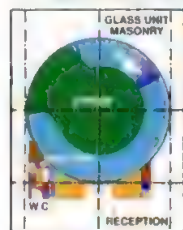
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**THE  POWER TO PUT ON
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THE SCREEN.  THE POWER TO **SCAN IN
24-BIT COLOR.**

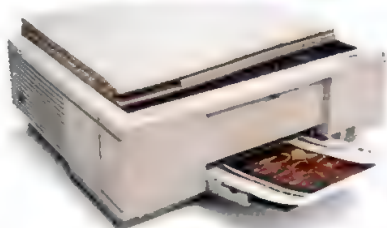
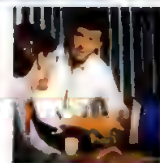
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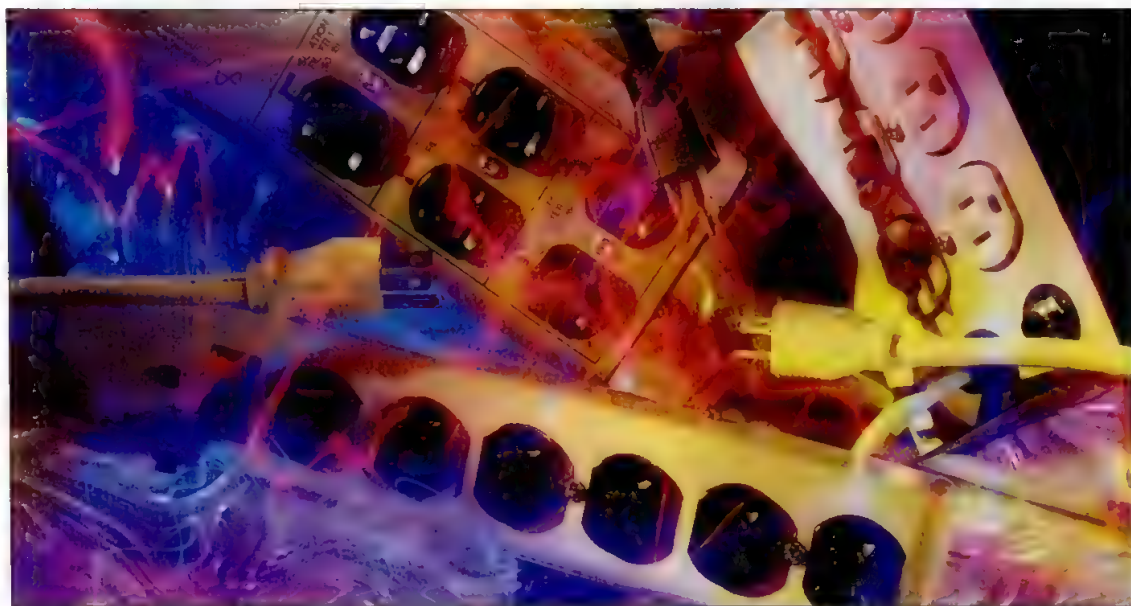
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Canon

SURGE SUPPRESSORS



Cutting Surges Down to Size

PC Magazine and ZD Labs review 32 surge suppressors that cost from \$12.95 to \$265.

Lightning is dangerous whether you fly a kite in a thunderstorm or stay inside working at your PC. The same pulse that electrifies your golf game can sneak into your power lines and send all the silicon in your system to its own solid-state heaven.

The culprit is the electrical surge—more voltage than your PC's components can handle. Lightning is but one of many causes of such surges. The brief jolts they deliver are unpredictable, unpreventable,

IN THIS STORY

Highlights.....	262
Editors' Choice.....	263
Thumbs Up/Thumbs Down	264
Surge Suppressor Product List.....	270
Summary of Features	278
Performance Tests.....	284
What the Numbers Mean	284
How We Tested.....	286

by Winn L. Rosch

H I G H L I G H T S

Surge Suppressors

POWER-LINE SURGES, though they are rare, can damage or even destroy PC hardware. Surge suppressors are designed to eliminate surges before they have a chance to damage or destroy your computer equipment. For this review, ZD Labs tested 32 in-line surge suppressors (those having a trailing cord to plug into a wall outlet) ranging in price from \$12.95 to \$265.

PCS ARE VULNERABLE to surges ranging from 800 to 6,000 volts. Typical PC power supplies can handle surges below 800 volts unaided. Surges in excess of 6,000 volts arc over in the wiring (short out) before reaching the computer. Allowing for a margin of safety, we believe surge suppressors should not let more than 500 volts pass through. Of the 32 units tested by ZD Labs, we rated 14 as acceptable: They allowed less than 500 volts to pass through. Twelve of the units passed from 500 to 700 volts and were rated marginal. Six passed more than 700 volts and were rated as failed.

NORMAL-MODE SURGES generally originate outside the building and are caused by utility-line switching and by lightning. *Common-mode surges* originate inside the building. Most industry experts maintain that you need protection from both types of over-voltage.

LOWER PASS-THROUGH voltages (below 500 volts) are desirable, but only to a point. Surge suppressors contain components that degrade as a result of repeated surges, and they degrade more rapidly if they're designed to reduce pass-through voltages further than necessary. The best surge suppressors achieve low pass-through voltage using multistage designs and separate circuits for the three conductor pairings. Among the 14 surge suppressors we rated as acceptable, you should make your buying decision based both on price and on features such as phone/fax protection, remote on/off switching, and warning indicators.

NOT ALL PC MAKERS recommend the use of surge suppressors. Compaq says that its computers are built to withstand surges and that the use of an external device might actually degrade surge protection.

POWER-PROTECTION DEVICES other than surge suppressors include uninterruptible power supply (UPS) systems, which provide emergency battery power (5 to 30 minutes) and are essentially similar to standby power system (SPS) units; line conditioners, which control voltage fluctuations; and line filters, which control line noise. Most UPS and SPS systems provide surge suppression.

and potentially lethal to electronic hardware.

Little wonder that surge suppressors are so compelling. These inexpensive plug-in creations can halt the worst surges before they reach your PC, stopping them dead in their tracks and keeping your hardware and data alive. In this article, *PC Magazine* and ZD Labs review 32 surge suppressors that cost from \$12.95 to \$265.

Though fleeting, electrical surges can cause great hardship. Not only can they destroy the circuitry inside your PC, but

they can also frustrate and embarrass those who try to judge them. We know. This article marks the third time in the last year *PC Magazine* has reviewed surge suppressors.

We continue our investigation not because of any breakthroughs in suppression technology, but because power surges themselves are as difficult to test as they are to stop. In fact, after we'd gone to print with last year's "Surge Suppressors Clamp Down on Spikes," *PC Magazine*, September 29, 1992, we discovered errors in our ZD Labs' testing

procedures that caused the great majority of surge suppressors to fail our tests. Improper grounding of our test probes resulted in erroneously high readings that left only four products with passing marks. Once we had discovered our problem, which was pointed out in part by the letters from several suppliers of surge suppressors, we retested all the products. In our January 12, 1993, issue, we published a correction and revised testing results, giving all but seven units a passing score in what, in retrospect, proved an evaluation procedure too mild to be discriminating.

*These inexpensive plug-in
creations can halt the worst
surges before they reach
your PC, stopping them
dead in their tracks.*

Learning from experience, we revamped and improved our tests: We subjected them to the scrutiny of experts in the electrical and measurement industry. We developed our test script with the assistance of James Breitmeier, president of Diversified Electronic Services, based in Melbourne, Florida, who was a member of the industry advisory group for the Underwriters Laboratory UL1449 specification, the principal industry surge suppression standard. (Breitmeier is also an industry consultant, and did not participate in our Editors' Choice discussions.) The configuration and operation of our test equipment was monitored by Kurt A. Meindorfer, vice president of Velonex, the testing-equipment manufacturer. (Meindorfer himself designed the equipment.)

In addition, our tests followed the rigorous IEEE C62.41-1991 procedures ("IEEE Recommended Practice on Surge Voltages in Low-Power AC Power Circuits") and C62.45-1991 ("IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits") procedures.

As a result, we have great assurance that this time, we have it right.

REVIEW CRITERIA

A PC power supply can handle over-voltages as high as 800 volts unassisted, though certainly the lower the voltage, the better the power supply's chance of surviving a surge.

Our review criteria focused our investigation on in-line units (those having a trailing cord to plug into a wall outlet) with at least six outlets, noise filtering, and an Underwriters Laboratory listing complying with its UL1449 standard. Other features, such as telephone line protection, were allowed but not tested. We asked manufacturers offering multiple models to choose one product that offers the best price/performance ratio for single-user PCs and workstations.

Other styles of surge suppressors are also available, principally console models, which are installed underneath the monitor, and wall-mount models, which plug into wall outlets without cables. (Electrical codes in some cities may not allow corded units, although such rules are more often honored in the breach.) We expected the products to have similar suppression capabilities regardless of packaging. Additional models and their features are listed in the company fact files for each product.

It is worth noting that not all PC vendors believe surge suppressors are necessary; Compaq Computer, for instance, states that all of its PCs are built to withstand surges. According to Compaq, adding an external surge suppressor that uses clamping to one of its systems may cause more damage than not using one, and therefore does not recommend the use of external surge suppressors with its PCs.

POWER PROTECTION CATEGORIES

Power protection comprises several categories in addition to surge suppressors.

Uninterruptible Power Supply (UPS) systems protect against blackouts and brownouts. Some UPSs (on-line models) use a battery as a buffer, constantly generating AC power locally using an inverter. Others combine ferro-resonant transformers for surge control and

Our Contributors: KATIE BARNES is a project leader at Ziff-Davis Labs. WINN L. ROSCH is a contributing editor to *PC Magazine*.



EDITORS' CHOICE

• Half work (but no standouts), half don't

Surges of less than 800 volts can be safely handled by the typical PC power supply, unaided, while surges of more than 6,000 volts arc over (short out) within your building wiring, usually with no damage, before they reach your PC. Surge suppressors guard

against the dangers that are in-between, reducing momentary over-voltages of from 800 to 6,000 volts to levels your computer can handle successfully.

Fourteen of the 32 surge suppressors tested by ZD Labs survived our battery of tests intact: They allowed less than 500 volts to pass through (lower is better) when they were bombarded by test surges of as many as 6,000 volts. We believe that the 14 units that passed all of our tests successfully are roughly equivalent in their ability to protect your computer.

None of the units we tested stands out enough to merit Editors' Choice to the exclusion of the others, so you should make your choice based on a combination of price and features such as arrangement of the outlets, phone line suppression, and indicator lights and alarms.

To allow for a margin of safety, we rated a surge suppressor acceptable if it passed less than 500 volts on all ZD Labs tests, marginal if it passed from 500 to 700 volts on one or more tests, and failing if it passed more than 700 or 800 volts (depending on the test). It's important to note here that surge suppressor units with pass-through

voltages substantially below 500 volts aren't necessarily better than those with higher pass-through voltages and might even wear out sooner.

These 14 products are rated as acceptable: American Power Conversion's Surge Arrest Plus with telephone suppression, EFI Electronics' PowerTrax 2000, Geist's Ultimate SRF-6MO/S-DP, Innovative Technology's SPIU-6, Joslyn Electronic Systems' Joslyn Model 1203-03 Surge Suppressor, L.E.A. Dynatech's Transient Tamer TT 415, NCR's Series 4000 Model 4070, Panamax's Max 6, Pass & Seymour/Legrand's Spec-Guard C6L, ProTek Devices' Surgebuster Model 1206K6, Proxima's Network-Grade Surge Protector Model S500, SL Waber's Wave Tracker WT6SS, Tripp Lite's Isobar 6 Ultra, and Woods Wire Products' Woods 5 623 Surge Suppressor.

We rated 12 other surge suppressors as marginal; they might or might not protect your computer, and they are priced in about the same range as the acceptable units (on average, \$100). The final six surge suppressors failed our tests outright; most of them were both cheaply made and low-priced.

backup batteries for blackouts. When power fails or drops below an acceptable level, these units provide enough battery power (5 to 30 minutes) to facilitate an orderly shutdown of the hardware.

Inexpensive *standby power systems* (SPSs), a variant of UPSs, combine battery backup with surge suppression of the type used in a power strip. These units switch to battery power within a few mil-

liseconds after detecting a power failure.

Our testing indicates there's no real-world difference between a UPS and an SPS in their ability to protect a PC against a power failure. Many UPS and SPS devices provide surge suppression.

Line conditioners provide tight voltage control, regulating fluctuations in voltage.

Line filters regulate electronic noise.



Thumbs Up, Thumbs Down

When 6,000 volts slam into a surge suppressor, unusual things can happen. Here are some things we liked and disliked about the 32 tested surge suppressors.—Katie Barnes and Winn Rosch



Pacific Electriccord Co.'s Electriccord XP Model A149-5006AS (\$14.95) failed because of a blown fuse—literally. A piece of the glass fuse body was blown out, leaving a noticeable hole.



An Auto-Sense feature on the Tandy 6-Outlet Power Center (\$69.95) senses when you flip your PC's power switch and powers up all six outlets. Unfortunately, our unit failed the tests.



Two thin layers of insulating paper separate the metal case from the circuit board of Perma Power's RS-610 (\$93.95). The surge suppressor failed when the surge arced through the paper.



While surge suppressors can last for decades, it's good to know they are working. In some cases, such as SL Waber's Wave Tracker WT6SS (\$124.95), the unit has a light that indicates it is still on the job; an alarm sounds if it isn't.



Minimally designed and grandly named, the GC-Thorsen Power Management System 64-631 (\$12.95) consists of just three metal oxide varistors (MOVs) with uninsulated leads. It failed after blowing an internal fuse.



Zero Surge's \$199 ZS1800 Surge Eliminator uses an inductor made from PVC pipe and nails, plus a bank of capacitors. Unfortunately, it offers no common-mode protection, and its ratings were marginal on our other tests.

1

The first stage incorporates, in series, either gas tubes or high-power (large-diameter) MOVs to handle the highest currents and quench power quickly.



3

Silicon avalanche diodes react quickly to control the first nanoseconds of a surge, then allow the other stages to dissipate the bulk of the surge energy.

2

The second stage comprises three high-current MOVs, one for each surge mode—line to neutral, line to ground, and neutral to ground—all suitably insulated.

An ideal surge suppressor has multiple stages to insure long life and to cope with both the largest and the most fleeting of surges. Each stage should include components for each possible surge mode and should be isolated by inductors to prolong life and improve response time.

Power Packed Upgrades.

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These UL/CSA approved, fully-tested power supplies are the best basic units available.

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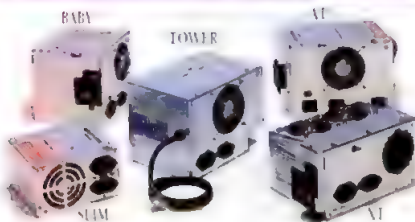


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TURBO-COOL 300 BABY	\$169
TURBO-COOL 300 AT/TOWER	\$189
TURBO-COOL 450 AT/TOWER	\$349

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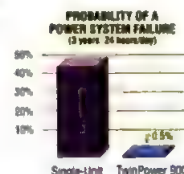
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- **Hot-Swap Capability.** In the unlikely event that one of its 450s should fail, an alarm sounds, and the other 450 sustains the server while the user simply swaps in a new unit. No downtime!

- **Optional Enclosures.** We offer "monster" cases that hold TwinPower's two power supplies and interface. The Commercial Tower (76 lbs.) holds 13 drives, while the all-steel Industrial Tower (102 lbs.) allows dual systemboards and holds up to 16 drives. Now, that's expandability!

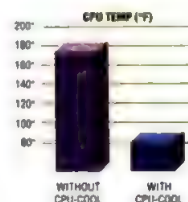
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CPU-COOL \$39

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□ Lotus 1-2-3 Windows 1.1 Item #61837-16	F3	\$ 315
□ Lotus 1-2-3 Windows 1.1 Upgrade Item #54832-16	F3	\$ 99
□ Microsoft Excel for Windows 4.0 Item #53253-16 (5.25 available)	F3	\$ 299
□ Microsoft Excel for Windows 4.0-Upgrade Item #44625 (5.25 available)	F3	\$ 119
□ Lotus 1-2-3 2.4 Item #67606-16	F3	\$ 335
□ Lotus 1-2-3 2.4 Item #69601-16	F5	\$ 335



\$99 Lotus 1-2-3 Upgrade

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□ WordPerfect 5.2 for Windows-Upgrade Item #57683-19 (5.25 available)	F3	\$ 79
□ Microsoft Word for Windows 2.0b Item #64932-19 (5.25 available)	F3	\$ 299
□ Microsoft Word for Windows 2.0b-Upgrade Item #62910-02 (5.25 available)	F3	\$ 119

Word Processing Con't		
□ Lotus Ami Pro 3.0 Item #55236-19	Dual	\$ 249
□ Lotus Ami Pro 3.0 Upgrade Item #32259-19	Dual	\$ 99
Database		
□ Borland Paradox 4.0 Item #63329-08	F3	\$ 499
□ Borland Paradox 4.0 Item #63325-08	F5	\$ 499
□ Borland Paradox 4.0 Upgrade Item #89829-08	F3	\$ 185
□ Borland Paradox 4.0 Upgrade Item #91828-08	F5	\$ 185
□ DataEase Express for Windows Item #85902-11	F3	\$ 145
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□ Symantec Q&A 4.0 Item #17461-13	F5	\$ 249

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□ Lotus SmartSuite Item #73818-13	F5	\$ 459
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□ Microsoft Office 3.0 Item #49836-13	F5	\$ 459
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General Con't		
□ Symantec Norton Desktop for Windows 2.0 Item #63129-11	F5	\$ 109
□ Quarterdeck QEMM 386 Item #45010-17	F3	\$ 59
□ Quarterdeck QEMM 386 Item #42019-17	F5	\$ 59

PERIPHERALS AND ACCESSORIES

Multimedia		
□ Creative Labs Multimedia Upgrade Kit Item #30738-25	Int	\$ 549
□ Creative Labs Sound Blaster Pro Item #61991-54	Int	\$ 189
□ MediaVision Pro 16 Multimedia System Item #23507-54	Int	\$ 899
□ MediaVision Multimedia Upgrade Kit Plus Item #38504-54	Int	\$ 735
□ MediaVision Fusion 16 Multimedia Upgrade Kit Item #88934-25	Int	\$ 499
□ MediaVision Pro Audio Spectrum 16 Item #01507-54	Int	\$ 199



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PFS Printer Bundle: Item PFSPRINT

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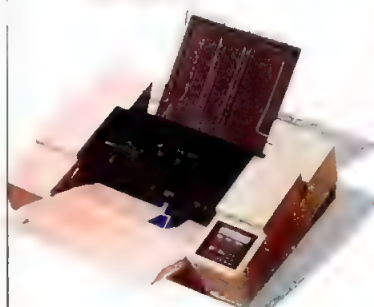
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Cardinal Technologies 2400 w/Prodigy Kit Item #000666-41	Int	\$ 39
Practical Peripherals 2400 SA 9600Fax Item #55492-41	Ext	\$ 109
Practical Peripherals 9600 SA w/QuickLink II Item #17710-41	Ext	\$ 305
Hayes Optima 96/Smartcard EZ.32/428IS Item #60063-41	Ext	\$ 349
Cardinal MB14400 V.32 w/Turbafax V.42 Item #40355-41	Ext	\$ 309



Lexmark Model 4079 Color Jet Printer

Input Devices

Logitech Mouseman Cordless Serial PS/2 Item #62063-35	\$ 87
Logitech Mouseman Serial PS/2 RH Item #75010-35	\$ 67
Microsoft Mouse-Bus Item #81453-35	\$ 89
Microsoft BallPoint Mouse w/Windows 3.1 Item #55034-35	F3 \$ 149
Logitech Scanman Model 256 Item #46485-53	\$ 263
The Complete PC Complete Page Scanner w/OCR Item #41725-53	\$ 549



\$189 Sound Blaster Pro

Monitors

NEC Multisync 3FGX Item #55195-23	\$ 689
NEC Multisync 4FG Item #75319-23	\$ 799
Radius PrecisionColor Display 19 Item #89497-23	\$2,229
Dell UltraScan 14C Item #320-3364	\$ 449
Dell UltraScan 15FS Item #320-3369	\$ 549

Printers

IBM/Lexmark Personal Printer II 9Pin 80Col Item #99025-27	\$ 349
IBM/Lexmark Personal Printer II 24Pin 80Col Item #87025-27	\$ 349
Epson AP-3250 Item #330-1482	\$ 205
Canon BJ-10 Ink Jet Item #72069-28	\$ 329
IBM/Lexmark Color Jetprinter 4079 LJ Item #12993-28	\$ 2,749
IBM/Lexmark 4070 LJ Item #79832-28	\$ 375
Epson EPL-8000 Item #330-3347	\$ 1,159

Printers Can't

IBM/Lexmark 4079 Laser Printer Item #79641-37	\$ 849
Genicom Model 7170 Item #12844-37	\$ 3,215
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Texas Instruments MicroLaser Basic Item #13399-37	\$ 899
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Quantum Prodrive ELS 85MB IDE Item #03731-34	Int \$ 215
Quantum Prodrive ELS 127MB IDE Item #09734-34	Int \$ 289
Quantum Prodrive ELS 170MB IDE Item #16736-34	Int \$ 325
Conner Sof-Star 3170 Item #76828-34	Int \$ 565
Colorado Jumbo 250 DJ-20 Item #88977-26	Int \$ 269

Product	Media	Price
Storage Can't		
Omega Tape 250 Insider Height Item #35848-34	Int	\$ 249

Networking

Arisoft Lantastic Windows Utility 4.1 Item #20664-36	Dual	\$ 179
Arisoft Lantastic Starter Kit 4.1 Item #89634-36	Dual	\$ 489
Novell Netware Lite 1.1 Item #02829-36	F5	\$ 59
Novell Netware Lite 1.1 Item #01827-36	F3	\$ 59
Windows for Workgroups Item #13151-17	F5	\$ 159
Windows for Workgroups Item #13166-17	F3	\$ 159
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14 RATED ACCEPTABLE

The 32 surge suppressors we found that qualified for review range in price from \$12.95 (GC-Thorsen Power Management System 64-631) to \$265 (Innovative Technology SPIU-6). In analyzing the results of lab-generated surges of as much as 6,000 volts, ZD Labs ranked the products in three tiers. First, we rated 14 products as *passing*—units that let through less than 500 volts (lower is better). They will keep surge energy from passing through to your equipment; they can withstand 6,000-volt 3,000-amp surges without failure. Second, we rated 12 units as *marginal*—those that let 500 to 700 volts (depending on measurement mode) to pass through their protected outlets on at least one test without failing any of the tests. Lastly, we rated six units as *failing*—those that let through more than

***We rated 14 units as
passing, 12 more as
marginal, and 6 as failing.
The average price of the 14
passing and 12 marginal
units was around \$100.***

700 volts on at least one test and those that were damaged or destroyed in testing by the surges.

The 14 units we rated as passing are:

- American Power Conversion's Surge Arrest Plus with telephone conversion;
- EFI Electronics' PowerTrax 2000;
- Geist's Ultimate SRF-6MO/S-DP;
- Innovative Technology's SPIU-6;
- Joslyn Electronic Systems' 1203-03 Surge Suppressor;
- L.E.A. Dynatech's Transient Tamer TT 415;
- NCR's Series 4000 Model 4070;
- Panamax's Max 6;
- Pass & Seymour/Legrand's SpecGuard C6L;
- ProTek Devices' Surgebuster Model 1206K6;
- Proxima's Network-Grade Surge Protector Model S500;
- SL Waber's Wave Tracker WT6SS;

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The **Back-UPS 250** offers even more cost-effective protection for LAN nodes (typical runtime for a 386SX system is 10 minutes).

NEW!



■ **ABSOLUTE™** Protection guarantees repair or replacement of equipment (up to \$25,000) if damaged by a surge while protected by a properly installed Back-UPS (See warranty for details).

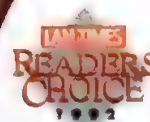
■ UL, CSA and Novell approved with a 2 year warranty

■ Full-time surge protection and line filtering

■ Most models include LAN interface for automatic-shutdown of Novell, LAN Manager, LAN Server, LANtastic, Banyan, SCO Unix, and others

■ Ask about PowerChute® UPS monitoring software and Novell compatible UPS monitoring boards

■ 230V models available



1991, 1990



Model	Application	List	New List
Back-UPS 250	LAN nodes, 386SX, 286, internet hardware, POS	\$109	\$139
Back-UPS 400	Desktop 386, 486 systems, 286 servers	\$249	\$229
Back-UPS 450	Tower 386, 486 systems, servers	\$229	\$279
Back-UPS 600	Heavily configured systems, CAD/CAM workstations	\$449	\$399
Back-UPS 900	Multiple systems, longer runtime applications		\$599
Back-UPS 1250	Multiple systems, LAN hubs, small minis, telecom equipment		\$799

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CIRCLE 162 ON READER SERVICE CARD

■ Surge Suppressor Product List

Diagnostic Power Refinery, Model 718

AESI/StediWatt, 205 Lincoln Way East, Chambersburg, PA 17201; 800-345-1280, 717-263-5681; fax, 717-263-1040.

List price: \$139.

Other models available: Diagnostic Telemate Refinery 618T (\$119, 6 outlets, 330 V), Pure Power Express Telemate 322T (\$79, 2 outlets, 330 V).

Circle 502 on reader service card

Surge Arrest Plus with telephone suppression

American Power Conversion Corp., 132 Fairgrounds Rd., West Kingston, RI 02892; 800-800-4272, 401-789-5735; fax, 401-789-3180.

List price: \$99.95.

Other models available: S7P (\$59.95, 7 outlets, 330 V), S3P (\$39.95, 3 outlets, 330 V), S7 (\$29.95, 7 outlets, 330 V).

Circle 503 on reader service card

Surge Reactor BN6-6

Brooks Electronics Inc., 4001 N. American St., Philadelphia, PA 19140; 800-523-0130, 215-228-4433; fax, 215-227-7687.

List price: \$80.45.

Other models available:

VCN 6-6 (\$43.53, 6 outlets, 400 V), VMP 4-6 (\$61.07, 4 outlets, 400 V), VCNR 6-6 (\$55.56, 6 outlets, 400 V).

Circle 504 on reader service card

Surge Stopper BPS-BN6-6

Brooks Power Systems, 1400 Adams Rd., Unit E, Bensalem, PA 19020; 800-523-1551, 215-244-0264; fax, 215-244-0160.

List price: \$94.95.

Circle 505 on reader service card

Ruby Plus

Curtis Manufacturing Co. Inc., 30 Fitzgerald Dr., Jaffrey, NH 03452; 800-955-5544; fax, 603-532-4116.

List price: \$119.95.

Other models available: Remote Ruby (\$109.95, 6 outlets, 400 V); Command Center (\$149.95, 5 outlets, 330 V); Emerald (\$69.95, 6 outlets, 400 V).

Circle 506 on reader service card

DataShield S100

DataShield, 500 N. Orleans St., Chicago,

IL 60610; 312-239-1601; fax, 312-644-6505.

List price: \$105.

Other models available: CPP12FM (\$54.95, 6 outlets, 400 V), S75 (\$69.95, 4 outlets, 400 V).

Circle 507 on reader service card

PowerTrax 2000

EFI Electronics Corp., 2415 South 2300 West, Salt Lake City, UT 84119; 800-877-1174, 801-977-9009; fax, 801-977-0200.

List price: \$99.95.

Other models available: PowerTrax 1000 (\$69.95, 6 outlets, 330 V); PowerTrax 3000 under-the-console (\$149.95, 5 outlets, 330 V); PowerTrax 2000 wall-mount (\$89.95, 2 outlets, 330 V).

Circle 508 on reader service card

Electripak 6SSU

Electripak, a division of Thomas & Betts Corp., 1555 Lynnfield Rd., Memphis, TN 38119; 800-888-0211; fax, 800-888-1017. **Estimated street price:** \$24.95.

Other models available: 6SSU-A (\$32 estimated street price, 6 outlets, 330 V), 4SF with telephone suppression (\$30 to \$35 estimated street price, 4 outlets, 330 V), 4SC with telephone/fax connectors (\$30 to \$35 estimated street price, 4 outlets, 330 V).

Circle 509 on reader service card

Power Management System 64-631

GC-Thorsen Inc., 1801 Morgan St., Rockford, IL 61102; 800-435-2931, 815-968-9661; fax, 815-968-9731.

List price: \$12.95.

Other models available: 64-690 with fax/modem protection (\$19.95, 6 outlets, 400 V), 64-130 (\$5.95, 1 outlet, 400 V), 64-680 (\$8.95, 3 outlets, 400 V).

Circle 510 on reader service card

Ultimate SRF-6MO/S-DP

Geist Inc., Flexiduct Division, P.O. Box 83088, Lincoln, NE 68501; 800-432-3219, 402-474-3400; fax, 402-474-4369.

List price: \$99.95.

Other models available: Wireless RC-5MO/S (\$124.95, 5 outlets, 400 V), RF-6MO/S (\$59.95, 6 outlets, 400 V).

Circle 511 on reader service card

SurgePro SP-6000NS

GE Wiring Devices, 225 Service Ave., Warwick, RI 02886; 401-886-6200; fax, 401-886-6250.

Estimated street price: \$29.95.

Other model available: SP-6000S (\$24.95 estimated street price, 6 outlets, 600 V).

Circle 512 on reader service card

Circuit Guard SS6

Hubbell Inc., Wiring Device Division, 1613 State St., Bridgeport, CT 06605-0933; 203-337-3100; fax, 203-579-2892.

Suggested trade price: \$153.95.

Other models available: SS6HG hospital-grade suppressor (\$185.25, 6 outlets, 330 V), SS4 (\$131.85, 4 outlets, 330 V).

Circle 513 on reader service card

Inland 3 Mode Surge Suppressor

Inland Corp., 32046 Edward, Madison Heights, MI 48071; 800-969-3705, 313-583-6220; fax, 313-583-9089.

List price: \$19.95.

Other models available:

Progarde 3 (\$69.95, 6 outlets, 400 V), Model 03183 (\$13.90, 6 outlets, 400 V), Model 03202 (\$9.95, 1 outlet, 400 V).

Circle 514 on reader service card

Innovative Technology SPIU-6

Innovative Technology Inc., 15470 Flight Path Dr., Brooksville, FL 34609; 904-799-0713.

List price: \$265.

Circle 515 on reader service card

Joslyn Model 1203-03 Surge Suppressor

Joslyn Electronic Systems Corp., P.O. Box 817, Goleta, CA 93116; 800-752-8068, 805-968-3551; fax, 805-968-0922.

List price: \$180.

Other model available: Model 1270-04 (\$65, 2 outlets, 400 V).

Circle 516 on reader service card

Power Tree 50

Kensington Microwave Ltd., 2855 Campus Dr., San Mateo, CA 94403; 800-535-4242, 415-572-2700; fax, 415-572-9675.

List price: \$69.95.

Other models available: Power Tree 20 (\$49.95, 6 outlets, 500 V), MasterPiece (\$149.95, 5 outlets, 330 V).

Continues

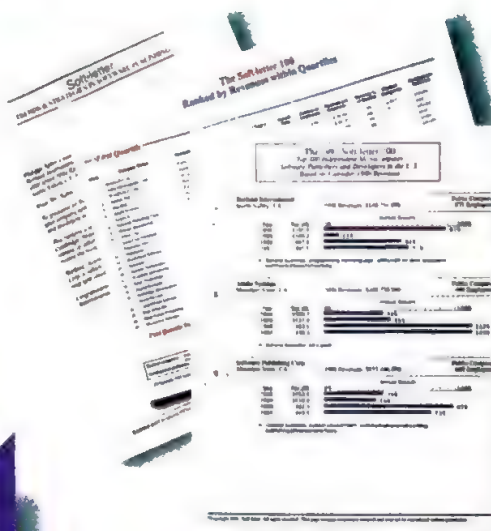
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HARDWARE
Surge Suppressors

Product List

CONTINUED

Circle 517 on reader service card

Transient Tamer TT 415

L.E.A. Dynatech, 6520 Harney Rd., Tampa, FL 33610; 800-654-8087, 813-621-1324; fax, 813-621-8980.

List price: \$87.

Other models available: TT 215 (\$65, 2 outlets, 330 V), TTM 215 with phone suppression (\$87, 2 outlets, 330 V).

Circle 518 on reader service card

NCR Series 4000 Model 4070

NCR Corp., 1334 South Patterson Blvd., Dayton, OH 45479; 800-262-7782.

List price: \$135.

Other models available: Model 4030 wall-mount (\$90, 3 outlets, 330 V), Model 4050 with power cord (\$105, 3 outlets, 330 V).

Circle 519 on reader service card

Electricord XP

Pacific Electricord Co., 747 W. Redondo Beach Blvd., Gardena, CA 90247; 800-326-8887, 310-532-6600; fax, 310-532-5044.

List price: \$14.95.

Other model available: HP

A1495006AS (\$30, 4 outlets, 400 V).

Circle 520 on reader service card

Panamax Max 6

Panamax, 150 Mitchell Blvd., San Rafael, CA 94903; 800-472-5555 (in U.S.A.), 800-443-2391 (in Canada), 415-499-3900; fax, 415-472-5540.

List price: \$99.

Other models available: Lanmax with data-line protection (\$149, 4 outlets, 330 V), Telemax 4 with telephone suppression (\$129, 4 outlets, 330 V).

Circle 521 on reader service card

SpecGuard C6L

Pass & Seymour/Legrand, P.O. Box 4822, Syracuse, NY 13221; 800-776-4035, 315-468-6211; fax, 315-468-6296.

List price: \$133.

Other models available: C4L-TEL with telephone suppression (\$165, 4 outlets, 400 V), C4L-COAX (\$165, 4 outlets, 400 V), C4L-RS232 (\$165, 4 outlets, 400 V), P2L (\$116, 2 outlets, 400 V).

Circle 522 on reader service card

Perma Power RS-610

Perma Power Electronics Inc., 5601 W. Howard Ave., Chicago, IL 60714; 800-323-4255, 312-763-0763; fax, 312-763-8330.

List price: \$93.95.

Other models available: RXD-410 with telephone suppression (\$77.95, 4 outlets, 330 V), RT-610 (\$56.95, 6 outlets, 400 V).

Circle 523 on reader service card

Surge Protector 300 Plus Model 106

Power Sentry Inc., 6543 City West Pkwy., Minneapolis, MN 55344; 800-852-4312, 612-942-6655; fax, 612-942-6828.

List price: \$15.99.

Other models available: Model 126 (\$9.95, 6 outlets, 400 V), Model 147 with telephone/fax suppression (\$9.95, 1 outlet, 400 V).

Circle 524 on reader service card

Surgebuster Model 1206K6

ProTek Devices Inc., 2001 W. Tenth Place, Tempe, AZ 85281; 602-968-6060; fax, 602-921-3760.

List price: \$96.

Other models available: 120K15A (\$103, 2 outlets, 330 V), 120KMP1 with telephone suppression (\$136, 2 outlets, 330 V).

Circle 525 on reader service card

Proxima Network-Grade Surge Protector Model S500

Proxima Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121; 800-447-7694, 619-457-5500; fax, 619-558-1408.

List price: \$74.95.

Other models available: W100 (\$29.95, 6 outlets, 330 V), S100 (\$49.95, 7 outlets, 330 V).

Circle 526 on reader service card

Wave Tracker WT6SS

SL Waber Inc., 520 Fellowship Rd., #306-C, Mount Laurel, NJ 08054; 800-634-1485, 609-866-8888; fax, 609-866-9845.

List price: \$124.95.

Other models available: Wave Tracker WT4M with modem protection (\$114.95, 4 outlets, 330 V), WT4 (\$94.95, 4 outlets, 330 V), WT2P wall-mount (\$59.95, 2 outlets, 330 V), WT8 (\$129.95, 8 outlets, 330 V), WT6 (\$114.95, 6 outlets, 330 V).

Circle 527 on reader service card

SRW GS-2

SRW Computer Components Co. Inc., 18385 Bandilier Circle, Fountain Valley, CA 92708; 800-547-7768 (CA only), 800-547-7766 (outside CA, but in U.S.), 800-331-7248 (U.S. and Canada), 714-963-5500; fax, 714-968-1543.

List price: \$34.95.

Other models available: GS-1 (\$29.95, 6 outlets, 340 V), GS-3 (\$44.95, 6 outlets, 340 V), GS-5 (\$54.95, 6 outlets, 340 V).

Circle 528 on reader service card

Tandy 6-Outlet Power Center

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011.

List price: \$69.95.

Circle 529 on reader service card

Isobar 6 Ultra

Tripp Lite, 500 N. Orleans St., Chicago, IL 60610; 312-329-1601; fax, 312-644-6505.

List price: \$104.95.

Other models available: Isotel 6 Ultra with fax/modem suppression (\$114.95, 6 outlets, 330 V), Isobar 4 (\$79.95, 4 outlets, 330 V), CCI 6 Plus (\$139, 6 outlets, 330 V).

Circle 530 on reader service card

Woods 5623 Surge Suppressor

Woods Wire Products Inc., 510 Third Ave., Carmel, IN 46032; 800-428-6168, 317-844-7261; fax, 317-843-1675.

List price: \$34.99.

Other models available: 5622 with coax protection (\$34.99, 6 outlets, 330 V), 5624 (\$29.99, 6 outlets, 330 V).

Circle 531 on reader service card

Zaptech Model MSS-206

Zaptech International Corp., 1902 Orange Tree Ln., #100, Redlands, CA 92374; 909-792-2229; fax, 909-792-5269.

List price: \$149.

Other models available: MSS-103 (\$19.99, 3 outlets, 400 V), MSS-306 with telephone suppression (\$289, 6 outlets, 400 V).

Circle 532 on reader service card

Zero Surge ZS1800 Surge Eliminator

Zero Surge Inc., 103 Claremont Rd., Bernardsville, NJ 07924; 908-766-4220; fax, 908-766-4144.

List price: \$199.

Other model available: ZS900 Surge Eliminator (\$149, 6 outlets, 330 V).

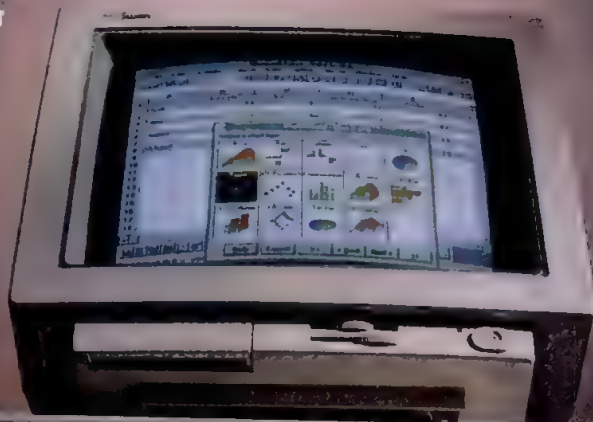
Circle 533 on reader service card

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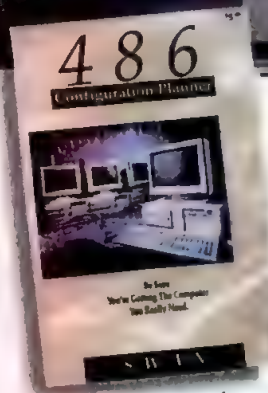
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Surge Suppressors

- Tripp Lite's Isobar 6 Ultra; and
- Woods Wire Products' 5623 Surge Suppressor.

The 12 units that allowed surges in excess of 500 or 700 volts (depending on measurement mode) to pass through their protected outlets are: AESI/StediWatt's Diagnostic Power Refinery Model 718, Brooks Electronics' Surge Reactor BN6-6, Brooks Power Systems' Surge Stopper BPS-BN6-6, Curtis Manufacturing's Ruby Plus, DataShield's S100, GE Wiring Devices' SurgePro SP-6000NS, Hubbell's Circuit Guard SS6, Inland's 3 Mode Surge Suppressor, Kensington Microware's Power Tree 50, SRW Computer Components' SRW GS-2, Zaptech International's MSS-206, and Zero Surge's ZS1800 Surge Eliminator.

The six units that failed our tests are: Electripak's 6SSU, GC-Thorsen's Power Management System 64-631, Pacific Electricord's XP, Perma Power Electronics' RS-610, Power Sentry's Surge Protector 300 Plus Model 106, and Tandy's 6-Outlet Power Center.

PRICE VS. PERFORMANCE

We found some correlation between price and performance, but only up to a point. Four of the five cheapest units failed (GC-Thorsen, Pacific Electricord, Power Sentry, and Electripak). The most expensive unit passed (Innovative Technology). But in between, the average price of both the 14 passing units and the 12 marginal units was about the same—around \$100.

We believe that the 14 units that passed all our tests are roughly equivalent in their ability to protect your PC, though none stood out enough to be awarded Editors' Choice. Make your choice based on a combination of price and features, and note that eight of the passing units list for less than \$100.

Since your PC can withstand 700–800 volt surges, why not consider one of the units we rated as marginally capable? We believe you should include a margin of variability to allow for manufacturing variances or ongoing design changes that might alter a unit's performance.

To test whether or not products vary, we selected two products for further testing: the Brooks Electronics Surge Reactor BN6-6 and the Brooks Power Systems

Surge Stopper BPS-BN6-6. The two companies are both in Pennsylvania, and both the construction and the names of their products are similar, although spokesmen for both companies say the companies are not related. In addition to testing the samples provided by the companies, we tested additional samples that we purchased from retail distributors. Two samples from each company passed all tests, while two other samples from each company failed or were rated as marginal by ZD Labs. Brooks Electronics says it has made an engineering change to its units since our tests. The second Brooks Power unit, bought a week after the first, had the same manufacturing date but different packaging.

*A PC power supply can
handle overvoltages as
high as 800 volts
unassisted, though
certainly the lower the
voltage, the better its
chance of surviving a surge.*

As a result of our testing, we rated both units as marginal because test results varied among the samples.

SURGE PROTECTION

Surges are a particular kind of anomaly on your power line that are part of a wider class called overvoltages, which occur when more than the expected voltage appears on your power lines. Not all surge overvoltages are the same: They differ in intensity, duration, and mode. The various facets of a surge influence its capability to damage your PC and the kind of protection that you require.

Voltage is one factor in characterizing surge intensity. PC power supplies are designed to deal with moderate overvoltages—five to ten percent nominal—and automatically compensate to keep the electricity going to your computer within acceptable limits.

In addition, ZD Labs testing showed

most PC power supplies can regulate brief surges—those lasting in the microsecond range (one millionth of a second)—of up to 800 volts without damage to internal PC components. Above 4,000–6,000 volts, your power cord or your building wire arcs over (short-circuits) momentarily, suppressing the surge before it hits your PC. You need protection (using a surge suppressor) for voltages in the range of 800 to 4,000 (or 6,000). Regardless, if your building suffers a direct lightning hit, you might suffer catastrophic damage to any electronic device, even with a surge suppressor connected.

By its nature, alternating current is an evanescent thing of sinusoidal waveforms that switch polarity 120 times a second (making 60 complete cycles in the same period). Note that in the alternating-current circuits that supply your PC, voltage is commonly measured in two ways: Line voltage is generally described as the geometric average of the cycling waves and is termed RMS (Root Mean Square—the means of calculating a geometric average), which describes the energy content of the electrical flow. Surges, however, are measured at peak values—the greatest excursion of the voltage level of the sinusoidal waveform. What passes for 120-volt utility power actually is a series of 170-volt peaks.

Because of the low resistance of power lines, high voltages are inevitably linked to high currents, and the resulting surges can contain huge amounts of power. The 6,000-volt, 3,000-ampere surge used in testing amounts to 18 megawatts—on a continuing basis, enough power to run a small city. Surges are thankfully short-lived, lasting a few millionths of a second. They contain a more modest amount of energy, perhaps a few hundred joules (watt-seconds), about the same amount of energy required to operate a light bulb for a couple of hours.

The reason surges cause damage is that this energy rushes through semiconductor circuits faster than they can dissipate it. Silicon junctions fry in microseconds (millionths of a second). The job of the surge suppressor is to absorb or reroute the surge energy before it reaches your PC.

Besides intensity and energy, surges

HARDWARE

Surge Suppressors

► SUMMARY OF FEATURES

Surge Suppressors

Products listed in alphabetical order	AESI/StediWatt Diagnostic Power Refinery, Model 718	American Power Con- version Corp. Surge Arrest Plus with telephone suppression	Brooks Electronics Inc. Surge Reactor BN6-6	Brooks Power Systems Surge Stopper BPS-BN6-6	Curtis Manufacturing Co. Inc. Ruby Plus	DataShield DataShield S100
☒ = YES ☐ = NO						
List price	\$139.00	\$99.95	\$80.45	\$94.95	\$119.95	\$105.00
Physical Characteristics						
Power cord length (inches)	75	72	72	72	72	72
Case material	Aluminum	Plastic	Metal	Aluminum	Plastic	Plastic
Number of outlets	7	7	6	6	6	6
Socket arrangement	Single row	Single row	Single row	Single row	Two rows	Two rows
Technology						
Capacitors	☒	☒	☒	☒	☒	☒
Inductors	☒	☒	☒	☒	☒	☒
Gas tubes	☐	☐	☐	☐	☐	☒
Number of MOVs	6	7	3	5	6	4
Size	22 mm	20 mm	20 mm	20 mm	14 mm	22 mm
Silicon avalanche diodes	☐	☐	☒	☒	☐	☐
UL ratings (pass-through voltage):						
Hot-to-neutral line	330V	330V	330V	330V	400V	400V
Neutral-to-ground line	330V	330V	330V	330V	400V	400V
Hot-to-ground line	330V	330V	330V	330V	400V	400V
Phone jack	\$20.00	☒	☐	☐	☒	☐
General Features						
Separate on/off switches for individual outlets	☐	☐	☐	☐	☐	☐
Suppression light/alarm	☒ ☐	☒ ☐	☒ ☐	☒ ☐	☒ ☐	☐ ☐
Circuit breaker	15 amps	15 amps	15 amps	15 amps	15 amps	10 amps
Technical support hours (eastern time except where indicated)	8:00-6:00 M-F	8:00-8:00 M-F	8:00-5:00 M-F	9:00-7:00 M-F	8:00-5:00 M-F	7:00-5:30 M-F
Standard warranty	5 years	Lifetime	Lifetime	Lifetime	Lifetime	Lifetime
Warranty covers damage to equipment plugged in	☒	☒	☐	☒	☐	☒
Maximum amount covered	\$20,000	\$25,000	N/A	\$2 million	N/A	\$5,000

N/A—Not applicable. The product does not have this feature.

also differ in their mode. Modern electrical wiring involves three conductors: hot, neutral, and ground. (If you think of this in terms of home wiring, hot is the live, black wire; neutral is the white, return wire; and ground is the third, green wire). Hot is the wire that carries the power; neutral provides a return path; and ground provides safety protection. The ground lead is ostensibly connected directly to the earth.

A surge can occur between any pairing of conductors: hot and neutral, hot and ground, or neutral and ground. The first pairing is termed normal mode. It reflects a voltage difference between the power conductors used by your PC. When a surge arises from a voltage difference between hot or neutral and

ground, it is called common mode.

Surges caused by utility switching (switching transients) and natural phenomena—for the most part, lightning—occur in the normal mode. The National Electrical Code requires that the neutral lead and the ground lead be bonded together at the service entrance (where utility power enters a building) as well as at the utility line transformer that's typically hanging from a telephone pole near your home or office. At that point, neutral and ground must have the same potential. Any external common-mode surge becomes normal mode.

Common-mode surges can, however, originate within a building because long runs of wire stretch between most outlets and the service entrance, and the resist-

ance and inductance of the wire allows the potential on the neutral wire to drift from that of ground.

Although opinions differ, recent European studies suggest that common-mode surges are more dangerous to your equipment. (European wiring practice is more likely to result in common-mode surges in that the bonding of neutral and ground is made only at the transformer.) Of the 32 devices we tested, only the Zero Surge ZS1800 lacked common-mode surge protection. Zero Surge does not consider common-mode surges to be a problem, however, believing that there isn't enough energy behind them to do the same amount of damage that normal-mode surges can do. Based on our discussions with industry experts, we believe

HARDWARE

Surge Suppressors

CONTINUES

EFI lectronics Corp. verTrax 2000	Electripak Electripak Model 6SSU	GC-Thorsen Inc. Power Management System 64-631	Geist Inc. Ultimate SRF-6MO/S-DP	GE Wiring Devices SurgePro SP-6000NS	Hubbell Inc. Circuit Guard SS6	Inland Corp. Inland 3 Mode Surge Protector	Innovative Technology Inc. Innovative Technology SPIU-6	Joslyn Electronic Systems Corp. Joslyn Model 1203-03 Surge Suppressor
\$99.95	\$24.95 (estimated)	\$12.95	\$99.95	\$29.95 (estimated)	\$153.95 (estimated)	\$19.95	\$265.00	\$180.00

72	48	72	72	72	72	48	60	72
Plastic	Metal	Steel	Plastic	Plastic	Steel	Plastic	Plastic	Aluminum
6	6	6	6	6	6	6	6	6
Single row	Single row	Single row	Two rows	Two rows	Single row	Single row	Two rows	Two rows

■	■	■	■	■	□	■	■	■
■	□	□	■	■	□	□	■	■
□	□	□	□	□	□	□	Info not available	■
6	3	3	4	2	4	3	Info not available	10
18 mm	20 mm	14.5 mm	20 mm	14 mm	20 mm	14 mm	Info not available	20 mm
■	□	□	■	□	□	□	Info not available	□
330V	330V	330V	330V	600V	330V	400V	330V	330V
330V	330V	330V	330V	600V	330V	400V	330V	330V
400V	330V	330V	330V	600V	330V	400V	330V	330V
\$29.95	□	■	■	□	□	□	\$20.00	□

□	■ (4 switched, 2 unswitched)	□	□	□	□	□	□	□
■ □	■ □	■ □	■ ■	■ □	■ □	■ □	■ □	■ □
15 amps	15 amps	15 amps	15 amps	15 amps	15 amps	15 amps	10 amps	15 amps
00-6:00 M-F	8:00-5:00 M-F	7:00-4:00 M-F	7:00-4:00 M-F	8:00-5:00 M-F	8:00-4:30 M-F	8:30-5:30 M-F	8:00-5:00 M-F	10:30-7:30 M-F
Lifetime	5 years	5 years	Lifetime	None	1 year	Lifetime	5 years	5 years
■	□	□	■	N/A	□	□	□	□
Unlimited	N/A	N/A	Unlimited	N/A	N/A	N/A	N/A	N/A

that you should look for a unit equipped with common-mode protection.

PROTECTION DEVICES

Four kinds of devices are most often used to protect against surges: metal oxide varistors (MOVs), gas tubes, silicon avalanche diodes, and reactive circuits. Each has its own strengths and weaknesses. Typically, commercial surge protectors use several technologies in combination.

MOVs are disk-shaped electronic components typically made from a layer of zinc oxide particles held between two electrodes. The granular zinc oxide offers a high resistance to the flow of electricity until the voltage reaches a breakover point. The electrical current then forms a low-resistance path between the zinc

oxide particles that shorts out the electrical flow.

MOVs are the most popular surge protection component because they are inexpensive to manufacture and easy to tailor to a particular application. Their energy-handling ability can be increased simply by enlarging them (typical MOVs are about an inch in diameter; high-power MOVs may be twice that.)

The downside to MOVs is that they degrade as a result of repeated hits. Surges tend to form preferred paths between the zinc oxide particles, reducing the resistance to electrical flow. Eventually, the MOV shorts out, blowing a fuse or (more likely) overheating the MOV until it destroys itself. MOV degradation, although real, has often been

overstated. In a properly designed surge suppressor, MOVs can be expected to last decades—longer than the service life of the equipment they are to protect.

Gas tubes are filled with special gases with low dielectric potential designed to arc over at predictable low voltages. The internal arc short-circuits the surge. Gas tubes can conduct a great deal of power—thousands of kilowatts—and react quickly, typically in about a nanosecond (one-billionth of a second).

On the negative side, a gas tube won't start conducting (and suppressing a surge) until the voltage that is being applied to it reaches two to four times the tube's rating. The tube itself does not dissipate the energy of the surge; it merely shorts it out, allowing your wiring to ab-

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO	Kensington Microware Ltd. Power Tree 50	L.E.A. Dynatech Transient Tamer TT 415	NCR Corp. NCR Series 4000 Model 4070	Pacific Electricord Co. Electricord XP	Panamax Panamax Max 6	Pass & Seymour/ Legrand SpecGuard C6L	
List price	\$69.95	\$87.00	\$135.00	\$14.95	\$99.00	\$133.00	
Physical Characteristics							
Power cord length (inches)	108	72	72	72	72	72	
Case material	Plastic and steel	Plastic	Plastic	Plastic	Plastic	Plastic	
Number of outlets	6	4	7	6	6	6	
Socket arrangement	Two rows	Two rows	Horseshoe	Single row	Two rows	Two rows	
Technology							
Capacitors	■	■	■	■	■	■	
Inductors	■	■	■	□	■	■	
Gas tubes	□	□	■	□	□	□	
Number of MOVs	3	7	6	3	6	6	
Size	23 mm	20 mm	20 mm	15 mm	20 mm	20 mm	
Silicon avalanche diodes	□	□	□	□	□	□	
UL ratings (pass-through voltage):							
Hot-to-neutral line	330V	330V	330V	400V	330V	400V	
Neutral-to-ground line	500V	330V	330V	400V	330V	400V	
Hot-to-ground line	500V	330V	330V	400V	330V	400V	
Phone jack	■	\$22.00	Prices vary	□	□	□	
General Features							
Separate on/off switches for individual outlets	□	□	□	□	□	□	
Suppression light/alarm	■ □	■ □	□ □	■ □	■ □	■ □	
Circuit breaker	15 amps	15 amps	15 amps	15 amps	15 amps	15 amps	
Technical support hours (eastern time except where indicated)	11:00-8:30 M-F	7:00-6:00 M-F	8:00-5:00 M-F (local time)	10:00-8:00 M-F	10:30-8:00 M-F	8:00-5:30 M-F	
Standard warranty	5 years	Lifetime	5 years	2 years	Lifetime	Lifetime	
Warranty covers damage to equipment plugged in	■	■	■	■	■	□	
Maximum amount covered	\$10,000	\$5,000	Unlimited	Varies	\$5 million	N/A	

N/A—Not applicable: The product does not have this feature

sorb the excess energy.

Worst of all, once a gas tube starts conducting, it doesn't like to stop. Typically, a gas tube requires a reversal of current

The toughest decision about surge suppression is whether you need any such device at all.

flow to quench (cut off) its internal arc, which means that the power going to your PC could be shorted for up to 8.33 milliseconds (one-thousandth of a second). Sometimes gas tubes continue to conduct

for several AC current cycles, perhaps long enough for your PC power supply to shut down. (Many PC power supplies switch off when power interruptions exceed about 18 milliseconds.)

Silicon avalanche diodes are semiconductor circuits that offer a high resistance to electrical flow until the voltage applied to them reaches a breakover potential. At that point, they switch on and act as conductors to shunt excess voltage. Silicon avalanche diodes operate more quickly than other protection devices but have limited power-handling capacity.

While MOVs, gas tubes, and silicon avalanche diodes share the same operating principle—eliminating the surge before it gets to your PC—the *reactive circuit* surge suppressor is different. The

one reactive surge suppressor in this review, the Zero Surge, uses a large reactance in the form of a hefty inductor (made from plastic plumbing pipe and finishing nails) and capacitor to resist the sharp voltage rise of a surge and spread it out over a longer time. Adding a capacitor tunes the reactance so that it can convert the surge into a semblance of a normal AC waveform. The other noise on the power line is also automatically absorbed.

Unfortunately, this form of reactive network has severe drawbacks. It doesn't eliminate the surge—it only spreads out its energy. The size of the inductor determines the spread, and a large inductor is required for effective results. In addition, the device only works on normal-mode

HARDWARE

Surge Suppressors

CONTINUES

Perma Power Electronics Inc. Perma Power RS-610	Power Sentry Inc. Surge Protector 300 Plus Model 106	ProTek Devices Inc. Surgebuster Model 1206K6	Proxima Corp. Proxima Network-Grade Surge Protector Model S500	SL Waber Inc. Wave Tracker WT6SS	SRW Computer Components Co. Inc. SRW GS-2	Tandy Corp. Tandy 6-Outlet Power Center	Tripp Lite Isobar 6 Ultra
\$93.95	\$15.99	\$96.00	\$74.95	\$124.95	\$34.95	\$69.95	\$104.95
72	48	72	72	72	72	72	72
Steel	Plastic	Metal	Plastic	Aluminum	Plastic	Plastic	Steel and aluminum
6	6	6	7	6	6	6	6
Single row	Single row	Single row	Single row	Two rows	Single row	Two rows	Two rows
☐	☒	☒	☒	☒	☒	☒	☒
☒	☒	☒	☒	☒	☐	Info not available	☒
☐	☐	☐	☐	☒	☐	☐	☐
3	3	8	6	5	3	3	8
22 mm	17 mm	20 mm	18 mm	20 mm	25 mm	Info not available	20 mm
☒	☐	☒	☐	☒	☐	☐	☐
330V	400V	330V	330V	330V	340V	340V	330V
330V	400V	330V	330V	330V	340V	340V	330V
330V	400V	330V	330V	330V	340V	340V	330V
☐	☐	☐	☐	☐	☐	☐	\$10.00
☐	☐	☐	☐	☐	☐	☐	☐
☒ ☐	☒ ☐	☐ ☐	☒ ☒	☒ ☒	☒ ☐	☒ ☐	☒ ☐
15 amps	15 amps	15 amps	15 amps	15 amps	15 amps	15 amps	12 amps
9:00-7:00 M-F	10:00-10:00 M-F	10:00-7:00 M-F	11:00-9:00 M-F	8:00-5:00 M-F	11:00-7:30 M-F	9:00-6:30 M-F	7:00-5:30 M-F
Lifetime	2 years	2 years	Lifetime	Lifetime	Lifetime	1 year	Lifetime
☒	☒	☐	☒	☒	☐	☐	☒
\$2 million	Unlimited	N/A	\$25,000	Unlimited	N/A	N/A	\$25,000

surges. The reactance may also cause a common-mode surge in the wiring leading to the device by raising the neutral line above ground potential, with possibly damaging results.

The simplest and cheapest surge suppressors are nothing more than three MOVs in a terminal strip. In ZD Labs' testing, these proved the most failure-prone. They were used by Electripak, GC-Thorsen, Pacific Electricord, and Power Sentry (all priced under \$25), all of which blew internal fuses or vaporized circuit traces when confronted with higher energy test surges.

Most commercial surge suppressors combine several of these technologies along with noise reduction circuitry. For example, the NCR Series 4000 Model

4070 connects gas tubes in series with MOVs to gain the benefits of each without the associated disadvantages.

Better surge suppressors usually incorporate multiple stages, isolated by inductors, to prolong life and improve response time. Heavy-duty components such as gas tubes or large MOVs form the first stage and absorb the brunt of the surge. A second stage with tighter control (more MOVs or silicon avalanche diodes) knocks the surge voltage down further. Only one of these more-complex units failed during evaluation (the Perma Power RS-610), and it was a victim of poor construction practice rather than inadequate electrical design (see "What the Numbers Mean").

Many surge suppressor manufacturers

tout EMI (electromagnetic interference) noise reduction circuitry as an additional feature of their products. However, external noise reduction is essentially irrelevant to PCs. All PCs must pass FCC Class B certification (for home use) or Class A verification (for business use). Both standards require PCs to prevent the noise and interference they generate from reaching the power line.

EXTRA FEATURES

A few surge suppressors complement their protection indicators with LEDs that show the condition of your outlet power. Although these indicators won't help in protecting your PC from surges, they will help guarantee your own safety. The American Power Conversion Surge

What's the
difference between
these two G's?

G G

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► **SUMMARY OF FEATURES**

ENDS

Products listed in alphabetical order

■ = YES □ = NO

Woods Wire Products Inc. Woods 5623 Surge Suppressor	Zaptech International Corp. Zaptech Model MSS-206	Zero Surge Inc. Zero Surge ZS1800 Surge Eliminator
---	---	---

List price	\$34.99	\$149.00	\$199.00
------------	---------	----------	----------

Physical Characteristics

Power cord length (inches)	48	72	72
Case material	Plastic	Plastic	Steel
Number of outlets	6	6	6
Socket arrangement	Single row	Two rows	Two rows

Technology

Capacitors	■	■	■
Inductors	■	□	■
Gas tubes	□	■	□
Number of MOVs	7	3	None
Size	14 mm	15 mm	N/A
Silicon avalanche diodes	□	□	□
UL ratings (pass-through voltage):			
Hot-to-neutral line	330V	400V	330V
Neutral-to-ground line	330V	400V	N/A
Hot-to-ground line	330V	400V	N/A
Phone jack	■	□	□

General Features

Separate on/off switches for individual outlets	□	■	□
Suppression light/alarm	■ ■	□ □	□ □
Circuit breaker	15 amps	15 amps	15 amps
Technical support hours (eastern time except where indicated)	8:00-5:00 M-F	12:00-9:00 M-F	9:00-5:00 M-F
Standard warranty	Lifetime	2 years	10 years
Warranty covers damage to equipment plugged in	□	□	■
Maximum amount covered	N/A	N/A	\$1 million

N/A—Not applicable. The product does not have this feature.

Arrest Plus adds a single wiring fault LED. Tripp Lite's Isobar 6 Ultra includes three LEDs: two green indicators that show protection is working and a red indicating line faults. DataShield's S100 includes indicators for normal voltage (green) and low voltage (red) and two switches—one to turn off its audible alarm, the other to reset it after a brown-out. Woods Wire Products' 5623 includes an illuminated power switch, a green ground LED, and a red surge LED—as well as a push button that allows testing its audible alarm. The EFI Electronics PowerTrax 2000 accommodates a power switch and four LEDs labeled Power, Protection, Outlet, and Ground. The cleverly styled Proxima S500 includes an audible indicator with a square test push

button and wiring and protection LEDs.

Tandy's 6-Outlet Power Center adds Computer Guard protection—if line voltage falls below 70VAC, it switches the entire box off and keeps it off until you press the reset switch. In addition, one outlet of Tandy's Power Center is endowed with Auto-Sense abilities, letting you place it out of the way. Plug your PC (or any device that uses up to 480 watts) into the Auto-Sense outlet and turn it on. The unit will then turn off and on the other five outlets in step. Turn off the device and the Power Center turns off—you don't have to actually touch the switch.

Although all of these surge suppressors give you at least six outlets, you'll find some more useful than others if you

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What the Numbers Mean

Of the 32 surge suppressors tested for this review, ZD Labs found 14 to have acceptable performance. Test results for all the surge suppressors are given in the table. Each suppressor was evaluated in terms of its maximum pass-through voltage on both normal-mode and common-mode surges.

Pass-through voltage is the voltage that gets through the surge suppressor to the computer system. We tested at four different AC power phase angles: 0, 90, 165, and 270 degrees. At 90 degrees on the sinusoidal waveform, the AC power is at its maximum of 165 volts. At 270 degrees, the AC power is at its minimum, or 0 volts. Testing in this manner gave us a feel for how each surge suppressor performs across the entire AC sine wave. The tabulated numbers represent the largest (most destructive) pass-through voltages we found over the four phase angles.

The performance of each surge suppressor under a normal-mode surge (injected line-to-neutral) is given in the first column. Normal mode reflects a voltage difference between the power conductors used by your PC.

In our testing, we found that an ordinary PC power supply (200-watt switching) could protect internal computer components from harm even when a direct normal-mode surge of 800 volts was applied. Since a number of PC power supplies perform below this average, and some complementary metal-oxide semiconductor (CMOS) components are extremely sensitive, we chose to set the acceptable limit of pass-through voltage at 500V or less. Thirteen of the surge suppressors tested did not meet this qualification.

The second and third columns give the results of the common-mode surges (surges injected line-to-ground or neutral-to-ground). When a

surge arises from a voltage difference between hot or neutral and ground, it is called a *common-mode surge*. Our PC power supply proved to be much more resilient in handling this type of surge while protecting the internal computer components. However, this type of surge does have the potential to damage the I/O components of network devices. For general protection of the computer, we set the criterion for acceptable common-mode pass-through voltage at 700V or less. An additional four surge suppressors did not meet this qualification.

Common-mode surges do not normally happen from one conductor to ground, as listed in the tables, but on both line and neutral with respect to ground. We tested for this as well but decided not to publish the results in the

interest of simplicity. We found that the pass-through voltages were slightly lower when the surge was injected into both line and neutral-to-ground, because the surge current was divided between the two lines. Nevertheless, injecting the surge on line-to-ground and neutral-to-ground separately, as we did in our testing, gives a better indication of how much protection there is on each of the lines.

Although the Perma Power RS-610 met the qualifications, we rated it as *failed* because of its poor construction. Two thin layers of paper were all that separated the line voltage from the chassis ground (outer case). During our tests on one Perma Power unit, a sharp soldered lead pierced a layer of paper. When the unit was hit with a surge, electricity arced over though the remaining layer of paper to the case. In such cases, the line voltage would temporarily be present on the outer case (a distinct hazard to the user if the unit is not properly grounded) until the device disabled itself. A second unit did not arc over, and the results of testing that unit are printed. The Brooks Electronics Surge Reactor BN6-6 and the Brooks Power Systems Surge Stopper BPS-BN6-6 are also victims of this kind of poor construction.

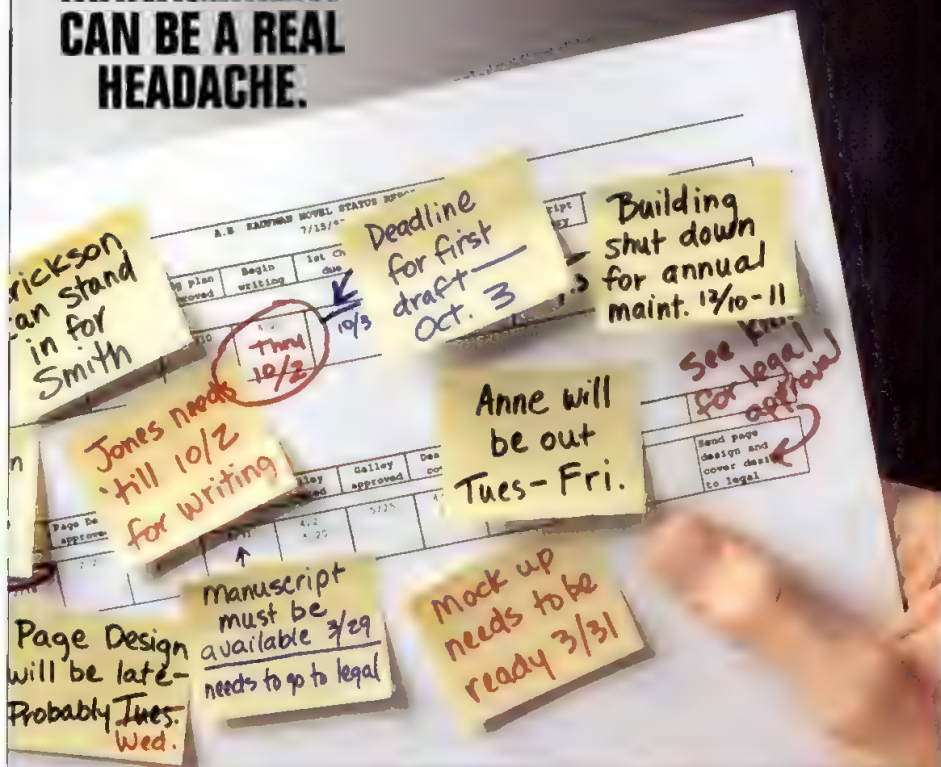
AC Power Phase Angles



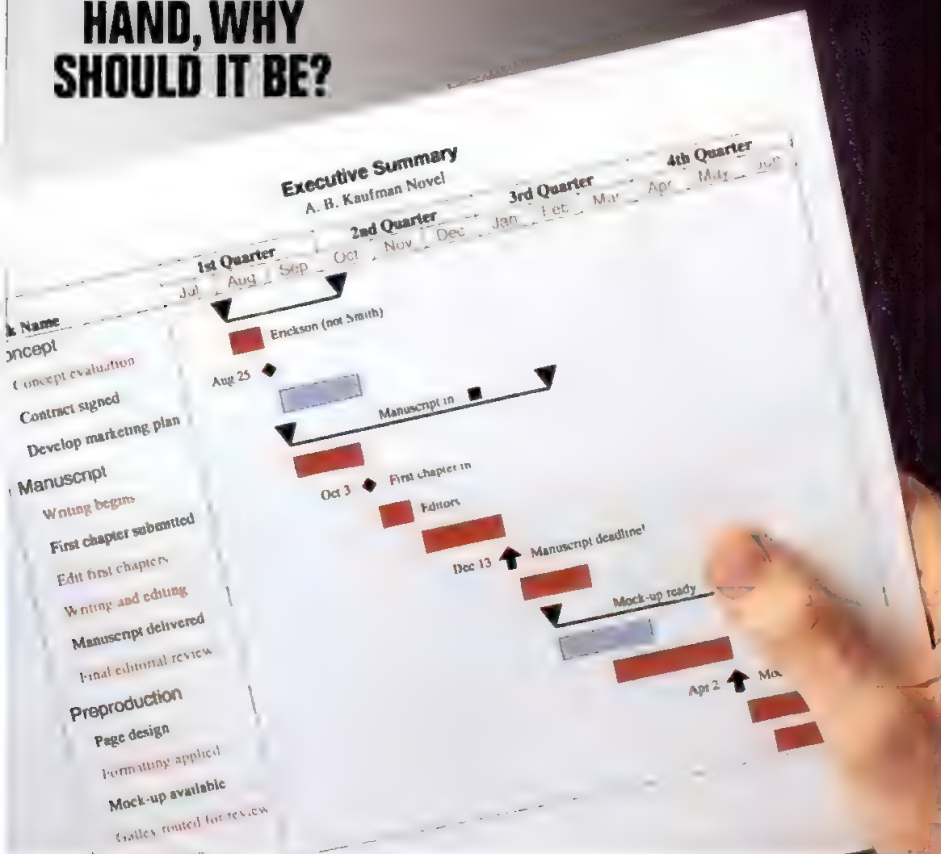
AC current is described by a sine wave that contains 60 complete cycles per second. Peak voltage (the surge we injected at 90 degrees, in this instance) is about 170 volts; the average is 120. ZD Labs injected surges at 0, 90, 165, and 270 degrees.

270°

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ZD Labs tested each of the 32 surge suppressors using the IEEE C62.41-1991 standard ("IEEE Recommended Practice on Surge Voltages in Low-Power AC Power Circuits"). In analyzing the results of lab-generated surges of as much as 6,000 volts, ZD Labs ranked the surge suppressors in three tiers: pass, marginal, and fail. There were 14 products considered passing (these were the units that consistently passed through 500 volts or less); 12 products were marginal, and 6 products failed.

How We Tested

At ZD Labs, surges conforming to the IEEE C62.41-1991 standard ("IEEE Recommended Practice on Surge Voltages in Low-Power AC Power Circuits") were generated by a Velonex 587C Impulse Generator. The generator contains large capacitors that store thousands of volts on a continuing basis; these can be injected into a line for testing purposes.

The surge output was coupled to the 120VAC power line using a Velonex V2980 Coupler Filter, which was used to select the path of injection (hot to

Performance Tests: Surge Suppressors

Lower scores represent better performance.

	100-kHz Ring Wave: 6,000V/500A			Combination Wave: 2,000V/1kA		
	Normal mode	Common mode (line to ground)	Common mode (neutral to ground)	Normal mode	Common mode (line to ground)	Common mode (neutral to ground)
Maximum pass-through voltage						
AESI/StediWatt Diagnostic Power Refinery, Model 718	528	784	680	400	552	496
American Power Conversion Surge Arrest Plus	240	504	520	416	368	400
Brooks Electronics Surge Reactor BN6-6	216	228	264	224	232	240
Brooks Power Systems Surge Stopper BPS-BN6-6	208	288	284	232	304	296
Curtis Manufacturing Ruby Plus	408	392	408	400	384	392
DataShield S100	392	704	816	384	568	576
EFI Electronics PowerTrax 2000	240	384	352	320	376	320
Electripak 6SSU	528	504	432	440	416	376
GC-Thorsen Power Management System 64-631	504	512	544	1,128/Dead*		
Geist Ultimate SRF-6MO/S-DP	312	288	304	328	336	344
GE Wiring Devices SurgePro SP-6000NS	696	968	536	544	976	600
Hubbell Circuit Guard SS6	424	448	744	368	376	740
Inland 3 Mode Surge Suppressor	592	552	320	528	520	528
Innovative Technology SPIU-6	232	316	356	264	316	320
Jaslyn Model 1203-03 Surge Suppressor	280	300	320	356	336	352
Kensington Microwave Power Tree 50	376	616	640	368	368	456
L.E.A. Dynatech Transient Tamer TT 415	408	364	400	352	368	388
NCR Series 4000 Model 4070	224	304	320	296	328	328
Pacific Electriccord XP	536	464	480	440	400	424
Panamax Max 6	376	360	392	344	344	360
Pass & Seymour/Legrand SpecGuard C6L	432	424	432	432	408	424
Perma Power RS-610	264	256	304	280	280	312
Power Sentry Surge Protector 300 Plus Model 106	528	472	504	448	440	440
ProTek Devices Surgebuster Model 1206K6	312	320	328	352	336	328
Proxima Network-Grade Surge Protector Model S500	272	352	344	312	288	304
SL Waber Wave Tracker WT6SS	288	360	328	336	368	376
SRW GS-2	528	496	544	480	488	496
Tandy 6-Outlet Power Center	592	536	536	440/1,592 Dead*		
Tripp Lite Isobar 6 Ultra	368	384	448	352	360	376
Woods 5623 Surge Suppressor	456	344	392	408	368	408
Zaptech Model MSS-206	648	784	824	600	576	624
Zero Surge ZS1800 Surge Eliminator	280	N/A	N/A	320	N/A	N/A

N/A—Not applicable. This product does not offer common-mode protection.

* This unit failed during the test. The first score indicates the pass-through voltage before the suppressor-working indicator went out. Where a second score appears, it represents the pass-through voltage on subsequent surges. "Dead" indicates that the unit was no longer functional and could not be used for subsequent tests.

neutral, hot to ground, and neutral to ground) and to prevent the surge from reentering the building wiring.

Each unit undergoing testing was supplied with 120VAC of superimposed surge from the coupler filter at the input of the power cord of the unit. The output of each unit was connected to a PC power supply (Behavior Technology's BTC Model PS-6220B) attached to 30 watts of resistive load to simulate the reactive input of a typical PC. In addition, one 150-watt lamp was connected to the surge suppressor output to provide further loading.

The output of the surge suppressor was monitored using a Tektronix TDS540 digital oscilloscope connected directly at the output jacks of the suppressor through three Tektronix P6015A high-voltage probes. The grounds of these probes were left floating and isolated from one another. Because some surge-suppressor industry consultants advise connecting the probe grounds together, several tests were run with grounds isolated and coupled; no difference in results was observed. A permanent graphical record of all test results was generated by connecting a

laser printer to the output of the oscilloscope.

Two surge waveforms were used for testing: a *100-kHz ring wave* (an exponentially decaying sine wave that simulates surges caused by switching transients) and a *combination wave* (a sharp rise-time impulse with exponential decay that simulates a lightning hit to the power line).

Surges were applied in increasing intensity to each device undergoing evaluation. Each device was required to withstand a series of 16 ring-wave and 48 combination-wave surges.

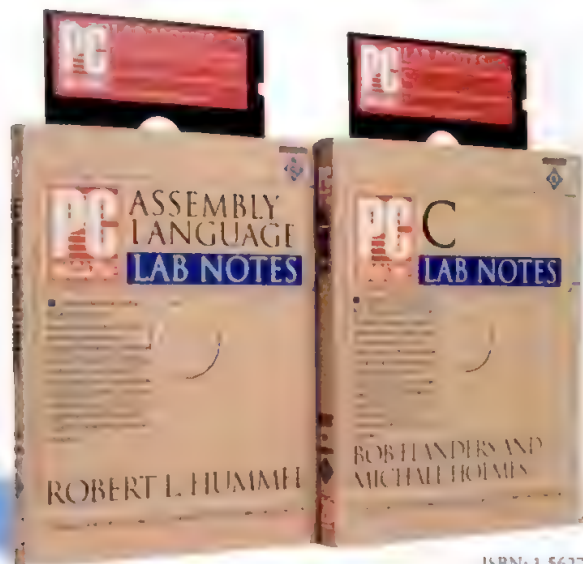
Ring-wave surges of 6,000 volts, 500 amperes were applied first. Surges were injected both in *normal mode* (line to neutral) and *common mode* (line to ground and neutral to ground). Each injection was repeated four times at different phase angles to the input AC waveform: 0, 90, 165, and 270 degrees; we report the largest pass-through voltage among the four phase angles. The 165-degree injection simulates a surge occurring in the middle of the sinusoidal waveform.

Combination waves were applied next, with the same injection and phase pattern as for the ring waves. Three series of combination waves of increasing intensity were presented to each device undergoing testing: 2,000 volts at 1,000 amperes, 4,000 volts at 2,000 amperes, and 6,000 volts at 3,000 amperes.

Testing was discontinued on any surge suppressor that failed. A total of 192 measurements were made for each device that completed the test process.

Combination Wave: 4,000V/2kA			Combination Wave: 6,000V/3kA		
Normal mode	Common mode (line to ground)	Common mode (neutral to ground)	Normal mode	Common mode (line to ground)	Common mode (neutral to ground)
496	648	584	552	736	640
424	416	464	432	416	576
400	392	432	424	424	472
248	312	304	256	320	312
512	424	576	616	512	584
408	664	648	424	704	736
328	400	344	328	424	368
904/Dead*					
360	368	376	392	400	400
648	1,152	656	728	1,216	736
426	416	750	480	456	780
592	568	592	660	672	672
264	328	332	264	332	348
384	352	376	384	360	392
408	568	624	440	704	736
392	400	460	416	432	488
288	336	360	304	352	352
496	496	520	592, 1,504/Dead*		
376	376	416	392	416	448
472	456	496	464	480	512
352	424	160/Dead*			
1,128/Dead*					
352	352	352	368	360	360
320	304	328	312	344	352
352	432	416	368	480	464
568	528	640	632	656	680
344	416	424	376	440	456
464	400	448	480	456	544
640	736	664	664	632	768
400	N/A	N/A	480	N/A	N/A

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need to plug in power transformer bricks in addition to ordinary power cords. For example, the horseshoe arrangement of outlets on the NCR Model 4070 virtually guarantees that any power brick will block more than one outlet.

The unit least amenable to power bricks is the Zero Surge ZS1800, which not only spaces its three duplex outlets closely—1.5-inch centers—but also surrounds its outlets with an extension of the metal case that can interfere with the proper seating of the transformers.

To augment the feeling of security

Each unit undergoing testing was supplied with 120VAC of superimposed surge from the coupler filter at the input of the power cord of the unit.

their products should give you, most surge suppressor manufacturers back their products with generous warranties. Sixteen of the products examined here offer lifetime warranties. Many cover not only the device itself but also the equipment plugged into it, with coverage ranging from \$5,000 (DataShield and L.E.A. Dynatech) to \$5 million (Panamax). Some (EFI, Geist, NCR, Power Sentry, and SL Waber) even promise unlimited protection to plugged-in equipment.

But these too-good-to-be-true claims may be exactly that. Most of these warranties are carefully worded and quite restrictive, requiring strict compliance with their terms. Proving that your equipment was damaged by a surge can be a difficult task.

The toughest decision about surge suppression is whether you need any such device at all. Surges powerful enough to damage electrical equipment are, in fact, rare. But the effects are so devastating that the small cost of a surge protector can be inexpensive insurance. You can't predict surges, and you can't prevent them. But at least you can stop them before they reach your PC. □

Numbers Runner

BY NEIL J. RUBENKING

NUMBERS RUNNER

I generate hundreds of numbered files and often need to manipulate a consecutively numbered subset of them—for example, to perform partial backups. Since this can quickly become a tedious chore, I wrote WITH.BAT, shown in Figure 1, which can execute a command a fixed number of times or automate any DOS operation that requires consecutive numbers. The syntax is

```
WITH ename=m,n command
[p1 p2 p3 p4 p5]
```

where *ename* is any valid environment variable name, *m* contains the start count, and *n* represents the end count. Each count can accept an integer greater than or equal to zero, with the size limited only by the computer's memory and the number of characters the command line can hold. If the process you want executed requires leading zeros, you'll have to pad *m* with zeros on the left so that it contains the same number of digits as *n*. Any program, batch file, or DOS command can substitute for *command*, which can be followed by up to five optional parameters (p1 through p5). Execution of the command may take some time when *m* is large. You can incorporate *ename* into any of the optional parameters by using the form %ename% as shown below. Invoked without any command, the batch file displays a syntax message. The command parameter must *not* call WITH.BAT itself—the second copy would overwrite files being used by the first copy.

To get a feel for using WITH, try this simple example:

```
WITH g=1,10 echo ^G %g%
```

which causes your computer to produce ten beeps, each followed by a display of the count prefixed with the number symbol (#). As another example, suppose you need to compress the files FILE10.DAT

through FILE25.DAT, storing them into FILESBAK.ZIP. Simply type

```
WITH c=10,25 PKZIP FILESBAK
FILE%c%.DAT
```

Rather than attempt a lengthy explanation of WITH's inner workings, I refer you to the heavily commented file itself. To understand how the batch procedure operates, comment out the @echo statement in order to follow the execution.

The most significant part of WITH—the counting routine—uses recursion to form numbers. Note that, with the exception of the command interpreter, the pro-

example, this command:

```
WITH X=12,24 ECHO %X%
```

prints the numbers from 12 to 24, inclusive. WITH is much more than a simple counter, though, since it makes the sequential numbers available to the repeated command.

Fortunately, you don't have to understand WITH.BAT in order to use it! For those who want to trace its action, I'll break it down into four phases. The first includes the lines up to the Init label. This section creates the temporary batch file \$.BAT, which contains both the command to be repeated and up to five parameters for it. WITH then reinvokes itself under a secondary command processor, passing an asterisk (as the first parameter) followed by the original first, second, and third parameters—the environment variable name, the start count, and the stop count. Running most of the process inside of a secondary command processor insures that—even in the event of a control-C or control-break interruption—all environment variables created by the batch file will be automatically cleared. Also, no matter how many times WITH calls itself, a simple EXIT command will end the secondary command processor and clear all of the recursive calls executed within it.

If the environment is almost full, WITH.BAT won't have enough environment space to create the variables it needs. The message "Out of environment space" is your signal that this has happened. To solve this, add a /E: parameter to the line that loads the secondary command processor; for example:

```
%COMSPEC% /E:512 /c %0 * %1 %2 %3
```

The number following /E: specifies the size (in bytes) of the environment for the secondary command processor. In most cases, 512 will be more than enough.

Phase two begins with the reinvoca-

Fortunately, you

don't have to

understand WITH.BAT

in order to use it!

gram uses no external commands—it relies strictly on the DOS batch language.

You won't find WITH.BAT particularly fast, but it occupies less than 1K of disk space (excluding the comments), making it at least 10 times smaller than a similar .COM or .EXE file.

Arnel P. Reyes

Los Alamos, New Mexico

► **PC MAGAZINE:** I went over WITH.BAT and added to the already copious comments—this is one *complicated* batch file. Give it a whirl and see how it works; for

IN THIS SECTION	
Tutor	295
Lab Notes	299
Utilities	306
Environments	313
Power Programming	325
Solutions	342

WITH.BAT

Complete Listing

```

@ECHO OFF
REM WITH.BAT
:* Initialization done? If yes, go to count.
IF '%1%'=='%0%' GOTO Count
:* Any command present on command line? If not, display syntax.
IF '%4%'=='%' GOTO syntax
:* In secondary command processor? If yes, do initialize.
:* Else start secondary processor.
IF '%1%'=='*' GOTO Init
:* Store command and its parameters to temporary file $.BAT
ECHO %4 %5 %6 %7 %8 %9 > $.BAT
:* Load secondary command processor and re-invoke this batch file, so
:* that all e-vars and recursion stack are cleared upon termination.
:* If you get "Out of environment space" error, add an /E: switch
:* before the /c - /E:512 should be more than enough in most cases.
:* Param * (asterisk) causes jump to label Init on re-invocation.
%COMSPEC% /c %0 * %1 %2 %3
:* Delete the temporary file $.BAT
DEL $.BAT
GOTO end

:==== Init =====
:* Initialize environment variables. Note: Previous re-invocation of
:* batch file using * (asterisk) as the 1st param has pushed ename,
:* m and n parameters into the 2nd, 3rd, and 4th parameter slots.
:* Set e-var & (ampersand) to param 4 (stop count) plus ampersand.
SET &=%4&
:* Set e-var n$ to param 4 (stop count).
SET n$=%4
:* Set e-var m$ to param 3 (start count).
SET m$=%3
:* Set e-var # (number sign) to param 2 (counter variable).
SET #=%2
:* Set e-var ! (exclamation point) to name of this batch file.
SET !=%0
:* Leading 0? If leftmost digit of m$ (start count) = 0 but
:* m$ not = 0, set 0 (leading zero flag) to 0.
IF NOT '%m$%'=='0' FOR %%a IN (/%%m$z) DO IF '%a%'=='0' SET 0=0
:* Re-invoke WITH.BAT w/o params - this time it jumps to label Count.
%0

:==== Count =====
:* E-var & initially contains stop count plus ampersand. Each recursion
:* clips the initial character. When only & is left, goto Process
IF '%&%'=='&' GOTO Process
:* Clip the first character from e-var &.
FOR %%a IN (/%%&) DO SET &=%%a

```

```

:==== Recurse =====
:* (1st time here results from last Init statement which invokes
:* WITH.BAT, passing no params. E-var + set to null, below, in that case.)
:* 1st param of a nested call? Set + to 1st param to find out.
SET +=%1
:* If %1=0, yes -- set + to value of lead 0 flag, 0. Else, + remains null
:* to 1st param. (0 is 0 if start count has leading zeros, null else.)
IF '%1%'=='0' SET +=%0%
:* Re-invoke batch file. Prefix each unit digit (0 - 9) of count w/the
:* count's leftmost digits, held in e-var +.
:* For binary counting, truncate CALL %1% statement starting at %&2.
:* For hexadecimal, add 0xA to %&F.
CALL %1% %&0 %&1 %&2 %&3 %&4 %&5 %&6 %&7 %&8 %&9
:* process next parameter
SHIFT
IF NOT '%1%' GOTO Recurse
:* append an ampersand to e-var & (now a re-nesting flag).
SET &=%&&
GOTO end

:==== Process =====
:* So $.bat can access it, store 1st param (number being processed)
:* into the count variable, whose name is contained in the e-var #
SET %1%=%1
:* Set e-var ^ to $ when the start count is reached. For it and
:* all numbers to stop count, $.BAT will be executed.
IF '%1%'=='%m$%' SET ^= $
CALL %^%
:* If reached stop count, exit secondary command processor,
:* ending all recursion and clearing all variables.
IF '%1%'=='%n$%' EXIT
SHIFT
:* Process next command line parameter
IF NOT '%1%' GOTO Process
GOTO end

:==== syntax =====
ECHO Syntax: WITH ename=m,n command [p1 p2 p3 p4 p5]
REM - command can be internal, COM, .EXE, or .BAT
ECHO - if with leading zeros, n and m must have same no. of digits
ECHO - ename is any variable, usable in p1, p2, etc. as %%ename%%

:==== end =====

```



Figure 1: This complex recursive batch file repeats a command over a series of sequential numeric values.

WITHSM.BAT

Complete Listing

```

@ECHO OFF
IF '%1%'=='%0%' GOTO Count
IF '%4%'=='%' GOTO syntax
IF '%1%'=='*' GOTO Init
ECHO %4 %5 %6 %7 %8 %9 > $.BAT
%COMSPEC% /c %0 * %1 %2 %3
DEL $.BAT
GOTO end
:==== Init =====
SET &=%4&|SET n$=%4|SET m$=%3|SET #=%2|SET !=%0
IF NOT '%m$%'=='0' FOR %%a IN (/%%m$z) DO IF '%a%'=='0' SET 0=0
%0
:==== Count =====
IF '%&%'=='&' GOTO Process
FOR %%a IN (/%%&) DO SET &=%%a
:==== Recurse =====
SET +=%1

```

```

IF '%1%'=='0' SET +=%0%
CALL %1% %&0 %&1 %&2 %&3 %&4 %&5 %&6 %&7 %&8 %&9
SHIFT
IF NOT '%1%' GOTO Recurse
SET &=%&&
GOTO end
:==== Process =====
SET %1%=%1
IF '%1%'=='%m$%' SET ^= $
CALL %^%
IF '%1%'=='%n$%' EXIT
SHIFT
IF NOT '%1%' GOTO Process
GOTO end
:==== syntax =====
ECHO Syntax: WITH ename=m,n command [p1 p2 p3 p4 p5]
:==== end =====

```



Figure 2: WITHSM.BAT is the same as WITH.BAT, but with the copious comments removed; it's amazingly small for what it does.

tion of WITH under the secondary command processor. This time, though, (due to the asterisk) execution jumps to the Init label. This section initializes several environment variables by storing the start count, stop count, and counter variable name into them. The & e-var also gets the value of the stop count, but followed by an ampersand (used later as a flag to tell when the last remaining digit of the stop count has been clipped off).

After setting the ! e-var to the %0 parameter's value (the batch file's own name), WITH invokes itself yet again.

In phase three, the very first IF statement causes a jump to the label Count because the e-var ! has the same value as parameter %0. This phase involves making several nested calls to WITH for each digit in the stop count. At each level of nesting, one digit is clipped from the stop count, and when no digits remain,

control is transferred to the label Recurse.

The loop starting at the label Recurse uses the SHIFT command to move each command line parameter into the %1 position for processing. This procedure sets the e-var + to the value of the first parameter, adjusting for leading zeros if necessary. When it re-executes WITH.BAT, it passes ten parameters consisting of the value of the + variable followed by each

of the ten digits from 0 to 9.

When all of the digits in the stop count have been processed, phase four begins. In phase four, the initial IF test still causes a jump to the label Count. However, since the variable & has been clipped down to a single ampersand, the IF test at the label Count causes a jump to the label Process. This label begins a loop that uses the SHIFT command to process each command line parameter. The parameters will be numbers built by the loop at the label Recurse.

The loop starts by assigning the value of the first parameter to the environment variable whose *name* is stored in the variable #. Next, it checks to see if the parameter is equal to the start count; if so, it sets the e-var named ^ to the value \$. This e-var is initially empty, so until the start count is reached, the next line (CALL % ^ %) does nothing. After the start count is reached, that line calls \$.BAT, which contains the command to be repeated. Although WITH.BAT must process all numbers from 0 to the stop count, it only calls the temporary batch file \$.BAT for those greater than or equal to the start count.

If a value equal to the stop count shifts into the first parameter during any repetition of this loop, the batch file calls the EXIT command, causing execution to return from the secondary command processor (invoked during phase one). This results in the clearing of all e-vars and any recursive invocations of WITH that have stacked up.

Note that although the recommended syntax uses an equal sign and a comma to delimit count parameters, any separator characters will do. You can also use semicolons, spaces, or tabs.

When you strip out all the comments from WITH.BAT, you get a batch file that's amazingly short, considering its complexity. Figure 2 is WITHSM.BAT, the small version of WITH.BAT. You'll want to execute this batch file and keep the fully commented WITH.BAT for reference. You can download both from PC MagNet archived as WITH.ZIP. □

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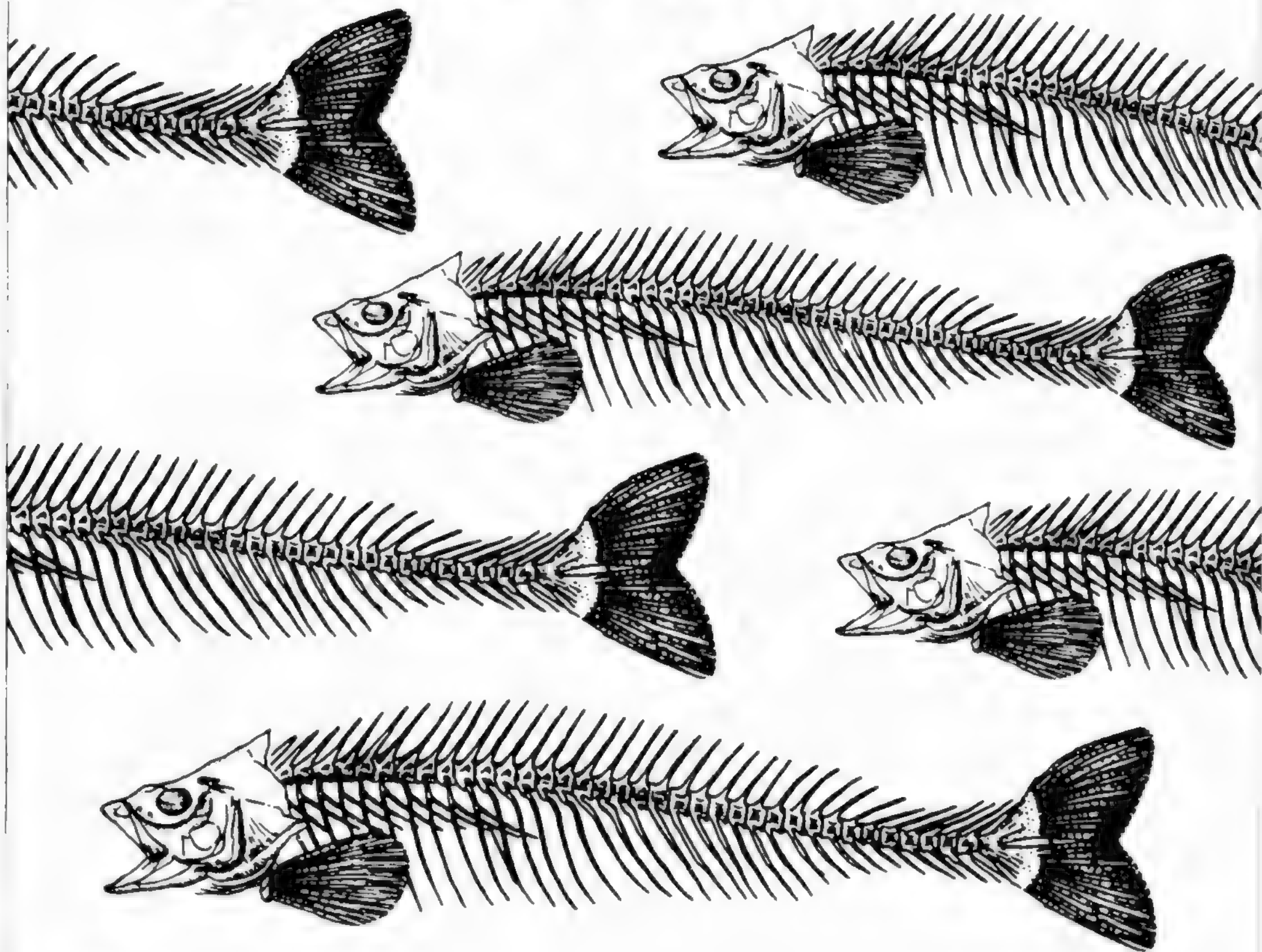
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The Truth About Free System Resources

BY JEFF PROSISE

Are there certain Windows applications that you just can't live without? If there are, you probably set up your system so that it would run Windows well. You probably upgraded the RAM in your PC and configured a swap file on your hard disk in order to take advantage of virtual memory. Then, after loading three or four applications, you discovered that Windows wouldn't let you load any more programs. Program Manager says that there are still several megabytes of RAM available, but to load another program, you have to close one of the active ones first.

What's going on here? You just learned the hard way that available RAM isn't the only factor that limits the number of programs you can load concurrently in Windows. A more unavoidable constraint is the amount of free system resources. In simple terms, *system resources* refers to a limited area of memory that Windows sets aside internally to store data about windows and objects created by Windows programs, and *free system resources* (FSR) is the percentage of this memory that isn't being used.

You can find out what your FSR percentage is from Program Manager's About box. Loading a large application such as Word for Windows or Excel generally uses up 5 to 10 percent of your FSR in Windows 3.1, and often more in Windows 3.0. No matter how much RAM your PC contains, Windows will refuse to load more programs when FSR approaches zero. Furthermore, it's wise never to let the FSR percentage drop too low. All sorts of strange things may happen when FSR goes below 10 or 15 percent, ranging from the benign—for example, icons losing their titles—to full-fledged system crashes.

FSR is something every Windows user should be aware of, but it is one of the aspects of Windows that isn't widely understood. In this installment of Tutor, you'll learn about system resources, how Windows handles them, and how that handling differs in 3.0 and 3.1. You'll also acquire a useful new utility for keeping tabs on FSR, complete with source code.

FREE SYSTEM RESOURCES DEFINED Windows relies extensively on *data structures*—collections of variables that are grouped together because they serve a related purpose. Many of these structures are not static, but are created and destroyed on-the-fly as circumstances re-

tended to be accessed directly and are therefore not documented. We only know about them through inference and through texts like *Undocumented Windows* by Andrew Schulman and others (1992, Addison-Wesley). Other items stored this way include menus, window classes, device contexts, and GDI (Graphics Device Interface) objects such as brushes, pens, bitmaps, and fonts. Each data structure that Windows creates consumes a small amount of memory. Free system resources is the percentage of memory that Windows sets aside to hold internal data structures that are currently unused.

Where does Windows find room to store the data structures? In the local heaps of two of the program modules (actually DLLs) that make up Windows—GDI.EXE and USER.EXE. In Windows, every program is assigned at least one data segment whose length is 64K or less. Part of the data segment is used to store variables created by the program, and part of it is used to hold the program's stack. The remainder of the segment—the free memory—constitutes the program's *local heap*. If desired, a program may allocate memory from its local heap by calling a Windows API function called LocalAlloc. GDI and USER contain their own local heaps, and it is inside these heaps that Windows stores the aforementioned data structures. These heaps are the *system resources* in *free system resources*.

To understand the mechanism by which system resources are consumed, consider what happens when a program creates a GDI brush. First GDI calls LocalAlloc to acquire enough heap space to hold a brush data structure. Then it initializes the data structure and passes the address back to the program that created the brush to use as a *handle*—a number

*Get savvy about
Windows' free system
resources: Here's a
clear explanation and
a utility that lets
you keep track of them.*

quire. For example, when you open a window, Windows creates a data structure in memory that belongs to Windows, and that data structure contains important information such as who the window's owner is, the window's size, and its position on the screen. Many windows contain other windows (controls such as buttons and list boxes are actually windows), so a single application program frequently begets several window data structures.

The window data structure is only one example of the many data structures that Windows uses internally. Many of these internal data structures were never in-

that uniquely identifies the brush. The free space in GDI's heap diminishes by the number of bytes required for the brush data structure. Given that there may be dozens (more likely, hundreds) of GDI objects defined in the system at any time, and that every one of them consumes space in GDI's heap, it's easy to imagine how the heap could fill up very quickly.

In Windows 3.0, USER contained two local heaps and GDI contained one. One USER heap stored data structures for windows, menus, window classes, and other USER objects; the other stored Window's global atom table (a system-wide "dictionary" to which programs can add and delete text strings). The GDI heap stored all data structures related to

Windows' Graphics Device Interface. By analyzing Windows 3.0 running real-world application programs, Microsoft determined that menus were causing the greatest strain on FSR, so in Version 3.1 they added two more heaps to USER—one to hold menu data structures and one to hold menu strings. GDI also gained an extra local heap in 3.1.

Earlier, we defined free system resources as the amount of memory remaining for Windows to store internal data structures. We can now refine this definition to say that in Windows 3.0, FSR is the percentage of free space remaining in the primary USER heap or the percentage of free space remaining in the GDI heap, whichever is less. In 3.0, USER typically ran out of heap space

long before GDI, so GDI rarely factored into FSR. It is not entirely clear how Windows 3.1 computes FSR. It probably divides total free space in the USER heaps by the combined length of the USER heaps, does the same for GDI, and reports the lesser of the two. It also appears that Program Manager doesn't use the GetFreeSystemResources API function, which debuted in Windows 3.1, because the percentage reported by the function and the one reported by Program Manager occasionally disagree by a percent.

The good news to users is that because of the increased heap space in USER and GDI, Windows 3.1 is less susceptible to FSR shortages than 3.0. But limited FSR is still a problem, and it is likely to continue to be until we move to a 32-bit oper-

FSR.C

1 of 2

```

.....
FSR displays the percentage of free system resources in real time.
Copyright (c) 1993 Jeff Promise. First published in PC Magazine,
U.S. Edition, March 16, 1993.
.....

#include <windows.h>
#include <stdlib.h>

#define WARNINGLEVEL 25
#define IDM_ALWAYSONTOP 100

extern DWORD FAR PASCAL GetHeapSpaces (HMODULE);
long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);
DWORD GetFSR (BOOL);

WORD wTimerID;           // Timer ID

.....
WinMain starts the program.
.....

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "Free System Resources";
    WNDCLASS wndclass;
    HWND hwnd;
    MSG msg;

    if (hPrevInstance)
        return FALSE;

    wndclass.style = CS_HREDRAW | CS_VREDRAW;
    wndclass.lpfnWndProc = (WNDPROC) WndProc;
    wndclass.cbClsExtra = 0;
    wndclass.cbWndExtra = 0;
    wndclass.hInstance = hInstance;
    wndclass.hIcon = NULL;
    wndclass.hCursor = LoadCursor (NULL, IDC_ARROW);
    wndclass.hbrBackground = GetStockObject (LTGRAY_BRUSH);
    wndclass.lpszMenuName = NULL;
    wndclass.lpszClassName = szAppName;

    RegisterClass (&wndclass);

    hwnd = CreateWindow (szAppName, szAppName, WS_OVERLAPPEDWINDOW,
CW_USEDEFAULT, CW_USEDEFAULT, 384, 96, NULL, NULL,
hInstance, NULL);

    if ((wTimerID = SetTimer (hwnd, 1, 1000, NULL)) == NULL) {
        MessageBox (hwnd, "Unable to allocate a timer", "Error",
MB_ICONEXCLAMATION | MB_OK);
        return FALSE;
    }

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0))
        DispatchMessage (&msg);

    return msg.wParam;
}

}

.....
WndProc processes messages to the main window.
.....

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
    static char szSection[] = "Options";
    static char szEntry[] = "AlwaysOnTop";
    static char szIniFile[] = "FSR.INI";

    static HPEN hGrayPen;
    static HBRUSH hPinkBrush, hRedBrush;
    static DWORD dwPercentFree, dwOldPercent;
    RECT rect, rectUsed, rectFree;
    DWORD dwVersion, dwTotal;
    static BOOL bWin31Flag;
    static HMENU hSysMenu;
    char szBuffer[4];
    PAINTSTRUCT ps;
    HDC hdc;

    switch (message) {

    case WM_CREATE:
        dwVersion = GetVersion ();
        if ((LOBYTE (LOWORD (dwVersion)) >= 3) &&
(HIBYTE (LOWORD (dwVersion)) >= 10))
            bWin31Flag = TRUE;
        else
            bWin31Flag = FALSE;

        hGrayPen = CreatePen (PS_SOLID, 1, RGB (128, 128, 128));
        hPinkBrush = CreateSolidBrush (RGB (192, 0, 192));
        hRedBrush = CreateSolidBrush (RGB (192, 0, 0));

        dwPercentFree = GetFSR (bWin31Flag);
        dwOldPercent = dwPercentFree;

        if (bWin31Flag) {
            hSysMenu = GetSystemMenu (hwnd, FALSE);
            AppendMenu (hSysMenu, MF_SEPARATOR, 0, NULL);
            AppendMenu (hSysMenu, MF_STRING, IDM_ALWAYSONTOP,
"Always on &Top");
            if (GetPrivateProfileInt (szSection, szEntry, 0, szIniFile)) {
                CheckMenuItem (hSysMenu, IDM_ALWAYSONTOP, MF_CHECKED);
                SetWindowPos (hwnd, HWND_TOPMOST, 0, 0, 0, 0,
SWP_NOMOVE | SWP_NOSIZE);
            }
        }
        return 0;

    case WM_PAINT:
        hdc = BeginPaint (hwnd, &ps);
        SetBkMode (hdc, TRANSPARENT);
        GetClientRect (hwnd, &rect);

        if (IsIconic (hwnd)) {
            if (dwPercentFree >= WARNINGLEVEL) {
                FillRect (hdc, &rect, GetStockObject (LTGRAY_BRUSH));
                SetTextColor (hdc, RGB (0, 0, 192));
            }
        }
    }
}

```

Figure 1: The source code for FSR.EXE, a Windows utility that tracks free system resources in real time.

FSR.C

2 of 2

```

else {
    FillRect (hdc, &rect, hRedBrush);
    SetTextColor (hdc, RGB (255, 255, 255));
}
DrawText (hdc, _itoa ((int) dwPercentFree, szBuffer, 10),
    -1, &rect, DT_SINGLELINE | DT_CENTER | DT_VCENTER);
}

else if ((--rect.bottom < 16) || (--rect.right < 32))
    FillRect (hdc, &rect, GetStockObject (LTGRAY_BRUSH));

else {
    InflateRect (&rect, -4, -4);

    SelectObject (hdc, hGrayPen);
    MoveTo (hdc, rect.left, rect.bottom);
    LineTo (hdc, rect.left, rect.top);
    LineTo (hdc, rect.right+1, rect.top);
    MoveTo (hdc, rect.right-1, rect.top+1);
    LineTo (hdc, rect.left+1, rect.top+1);
    LineTo (hdc, rect.left+1, rect.bottom);

    SelectObject (hdc, GetStockObject (WHITE_PEN));
    MoveTo (hdc, rect.left+1, rect.bottom);
    LineTo (hdc, rect.right, rect.bottom);
    LineTo (hdc, rect.right, rect.top);
    MoveTo (hdc, rect.right-1, rect.top+2);
    LineTo (hdc, rect.right-1, rect.bottom-1);
    LineTo (hdc, rect.left+1, rect.bottom-1);

    InflateRect (&rect, -2, -2);
    rect.right++;
    rect.bottom++;
    CopyRect (&rectUsed, &rect);
}

```

```

CopyRect (&rectFree, &rect);
dwTotal = (DWORD) (rect.right - rect.left);
rectFree.right = rectFree.left +
    ((int) ((dwTotal * dwPercentFree) / 100));
DeleteObject (hRedBrush);
DeleteObject (hGrayPen);
PostQuitMessage (0);
return 0;
}

return DefWindowProc (hwnd, message, wParam, lParam);
}

.....
GetFSR returns a value between 0 and 100 that quantifies the
percentage of free system resources.
.....

DWORD GetFSR (BOOL bWin31)
{
    DWORD dwHeapSpaces;
    WORD wUserPercentFree, wGDIPercentFree;

    if (bWin31)
        return ((DWORD) GetFreeSystemResources (GFSR_SYSTEMRESOURCES));
    else {
        dwHeapSpaces = GetHeapSpaces (GetModuleHandle ("USER"));
        wUserPercentFree = (WORD) (((DWORD) (LOWORD (dwHeapSpaces)) * 100) /
            ((DWORD) (HIWORD (dwHeapSpaces))));
        dwHeapSpaces = GetHeapSpaces (GetModuleHandle ("GDI"));
        wGDIPercentFree = (WORD) (((DWORD) (LOWORD (dwHeapSpaces)) * 100) /
            ((DWORD) (HIWORD (dwHeapSpaces))));
        return ((DWORD) min (wUserPercentFree, wGDIPercentFree));
    }
}

```

ating system such as Windows NT or OS/2. In 16-bit Windows, increasing the heap space would mean creating more local heaps or moving internal data structures to the global heap. The former is undesirable because it would make Windows as a whole more fragmented (that is, the data structures would be divided among more heaps) and still not solve the problem (if one local heap fills up, you may still run out of FSR even if the other heaps are nearly empty). The latter would bog down performance because of the segment register manipulations required. A 32-bit operating system makes the issue of local versus global heaps moot, because the 386 and 486 do not suffer from 64K segmentation limits.

GAUGING FREE SYSTEM RESOURCES Figure 1 lists the C source code for a Windows utility named FSR.EXE, which tracks free system resources in real time. When it is displayed as a window, FSR draws a horizontal bar that represents the percentage of free system resources, as shown in Figure 2. The bar scales to the size of the window, so you can make it as large or as small as you'd like. If free system resources fall below 20 percent, the bar changes from magenta to red as a warning. When it is reduced to an icon, FSR displays the percentage of free system resources in numeric form. The display is updated once a second. With FSR running, you should never again have to open Program Manager just to check free system resources.

The heart of FSR is the function named `GetFSR`, which returns a `DWORD` (double word) value equal to the percentage of system resources free. In Windows 3.1, `GetFSR` calls the documented `GetFreeSystemResources` function to get a count of free system resources. In Windows 3.0, it calls the undocumented `GetHeapSpaces` function, which accepts a module handle and returns a `DWORD` whose high word is equal to the number of bytes in

the default local heap and whose low word is equal to the number of free bytes in the heap. `GetFSR` calls `GetHeapSpaces` once with the module handle of `USER` and once with the module handle of `GDI`, computes percent free in each module by dividing free bytes by total bytes and multiplying by 100, and then returns the lesser of the two percentages. `GetHeapSpaces` was discussed in *PC Magazine's* November 12, 1991, Windows column, and it is treated at length in *Undocumented Windows*. `GetHeapSpaces` produces erroneous results in Windows 3.1, because it does not take into account the additional heaps set aside for `USER` and `GDI`.

If you run it under Windows 3.1, FSR adds an "Always on Top" option to its system menu. When checked, "Always on Top" ensures that the FSR window stays visible even if another application is running full-screen. The program remembers how you last set it and automatically assumes the same configuration the next time you start it. You can download the FSR executable and related files from the Tutor section of the Utilities/Tips Forum on PC MagNet. FSR.EXE is the executable only; FSR.ZIP contains FSR.EXE, a document file, the source code, and the other files you need to compile FSR.EXE with Microsoft C 7.0 and Windows 3.1's SDK. □



Figure 2: The horizontal bar presented by FSR.EXE graphically shows your free system resource percentage.

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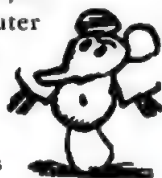
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Communications Programming In Windows 3.1

BY MARK DOUGLAS

Unreliability was the hallmark of Windows 3.0 modem communications. Windows 3.0 applications faced performance problems that caused them to lose characters—consistently at 9,600 bps and sometimes even at 2,400 bps. Fortunately, programmers can solve those performance problems simply by using the additions incorporated in the Windows 3.1 communications API. The new API also provides welcome support for such newer communication processors as the National Semiconductor NS16550A.

Communications programming was difficult in Windows 3.0, and unfortunately, it's still difficult in Windows 3.1. Much of the problem for programmers stems from a lack of good information. This article will overcome that obstacle by presenting a communications API tutorial that includes some material that is missing or inadequately documented in the Windows SDK reference.

The other difficulty facing the Windows 3.1 communications programmer arises from the fact that the cooperative multitasking kernel in Windows requires that periodically every active program be given a chance to run. Balancing the needs of the communications device, which demands constant attention, with the needs of other Windows applications, which rely on your program to give them some CPU time, is a challenge you must simply accept when you do communications programming under Windows.

UNDERSTANDING THE API The Windows communications API includes the 17 serial communication functions that are listed in Figure 1. I've divided them into three groups: (1) Access Functions, which give you exclusive control of a communications device; (2) Data Func-

tions, which let you send and receive data; and (3) Status Functions, which let you set the state of a device and which also let you set flow control management. If you're a die-hard DOS programmer, you can, of course, bypass Windows and access the communications hardware directly—even in a Windows program. But by using the Windows functions instead, your communications code will run faster, your program will run under Microsoft Windows NT, and your program will automatically support new communi-

*Filling in the gaps
and correcting the errors
in the SDK will give
programmers full access
to a much-improved
communications API.*

cations hardware.

This last point is worth emphasizing. Like Windows display and printer drivers, Windows communications drivers provide device independence. By choosing to write your software using the Windows communications API, however, your programs will automatically support new communications hardware as it becomes available. For example, without changing the source code, your programs will support the Hayes ESP (Enhanced Serial Port) and network modems, such as the Shiva NetModem.

OPENING A DEVICE Windows communications functions other than `OpenComm()` and `BuildCommDCB()` require a communications device identifier (device ID) as their first parameter. To get

a device ID, you must call the `OpenComm()` function, so this call is almost always the first function call to the communications API. The syntax for `OpenComm()` is

```
int OpenComm(lpszDevControl,
             cbInQueue, cbOutQueue)
```

The first parameter specifies the name of the communications port. The port name is passed as a null-terminated string in the form `COMn`, where *n* is the serial port number (for example, `COM1`). The other two parameters specify the size, in bytes, of the receive and send queues. Windows uses the queues to buffer the data it receives from a device and to buffer the data the application is ready to send. Because Windows applications take turns executing, data can come into the communications port while your program is dormant. To avoid losing this data, therefore, Windows (specifically, the `COMM.DRV`) buffers the data in the receive queue. When your program gets its turn, it retrieves the data from the queue.

The receive queue should be set to a size that minimizes the possibility of losing data. Data can be lost if Windows receives data faster than your program can remove it from the queue. If data is lost, Windows will notify your program through an overrun error, but you can usually avoid such errors if you read data in large blocks and specify a queue size that can hold between 5 and 10 seconds of received data.

Five seconds of received data amounts to about 6K at 9,600 bps, or 1.5K at 2,400 bps. The receive queue has a maximum size of 32K (32,767 bytes). Making the queue larger than absolutely necessary is a very good idea: A large queue doesn't slow Windows down any, and it helps

The Windows 3.1 Communications API

ACCESS FUNCTIONS

OpenComm

CloseComm

DATA FUNCTIONS

ReadComm

WriteComm

SetCommBreak

ClearCommBreak

TransmitCommChar

UngetCommChar

FlushComm

STATUS FUNCTIONS

GetCommState

SetCommState

GetCommEventMask

SetCommEventMask

GetCommError

BuildCommDCB

EnableCommNotification

EscapeCommFunction

Figure 1: The Windows 3.1 communications API is neither simple nor elegant, but it can be mastered if you know how to use the 17 functions listed above.

prevent the chance of getting an overrun error.

If the OpenComm() call is successful, your program will get a device ID, which is similar to a file handle. The device identifier is used by all other communication functions, as it uniquely identifies the communications device your application is accessing.

If you call OpenComm() and the communications device is already open, the OpenComm() call will fail and will return the error code IE_OPEN. You can also use OpenComm() to determine if a device is already open without actually attempting to open it. If you call OpenComm() with the send and receive queue sizes set to zero, the result will be the error code IE_OPEN if the device is open or IE_MEMORY if the device is closed.

CONFIGURING THE DEVICE After opening a communications device, the next step is to configure it. You configure the device by calling SetCommState(), whose syntax is

```
int SetCommState(lpdcb)
```

The SetCommState() function requires a single parameter, namely, a pointer to a Device Control Block (DCB) structure. Every field in this structure is explained in detail in the sidebar entitled "The DCB Structure." The DCB structure specifies the baud rate, together with other such modem settings as parity and stop bits, that Windows should use when communicating. The DCB structure also specifies what type of flow control you

want Windows to use. Windows can use software, hardware, or no flow control.

Flow control is needed so that a receiving application can tell the sender to stop or to resume sending data. This allows your program to prevent overrunning the receive queue. Software flow control uses two characters, usually the XON (Ctrl-S, or 0x13) and XOFF (Ctrl-Q, or 0x11), to control the sender. If your appli-

cation turns on software flow control, Windows will send an XOFF character whenever the receive queue is nearly full. It will then send an XON character when the queue starts to reempty.

Instead of sending characters, hardware flow control uses dedicated lines in the serial cable to control the sender. This limits the use of hardware flow control to situations in which your computer and the sender are directly attached. You might, for example, use hardware flow control between your computer and your modem or between your computer and another nearby computer. The advantage of using hardware flow control is that it reduces the amount of data that must be transmitted, since control is maintained by the dedicated lines. Hardware flow control also frees the sender from having to look for the XOFF character, as it must with software flow control.

Having flow control support built into Windows saves you a lot of programming. The DCB structure is complex, and every field in that structure must contain a valid value. No less than 15 of the 28 fields are flow control related. To simplify using the DCB structure, you can call the GetCommState() function to retrieve the current DCB settings before changing them. After retrieving the current settings, you can then make changes only to the DCB fields in which you are interested. Note that after changing the DCB structure, your program must call SetCommState() to notify Windows of the changes. The following example

shows how to call the GetCommState() and SetCommState() functions:

```
DCB dcb;
GetCommState(idDevice,&dcb);
dcb.Id = idDevice;
dcb.BaudRate = CBR_9600;
dcb.ByteSize = 8;
...
SetCommState(&dcb);
```

As an alternative way to set the DCB structure, Windows provides the BuildCommDCB() function. This function is useful when you care only about the basic data settings, for example, baud rate and data bits. The BuildCommDCB() function accepts the same string as the DOS MODE command does, and it fills in the DCB structure accordingly. For example, the string

```
"COM1:2400,n,8,1"
```

sets the DCB structure to 2,400 bps, no parity, 8 data bits, and 1 stop bit.

By default, the BuildCommDCB() function sets the DCB structure so that both hardware and software flow control are turned off. If you want to use flow control, therefore, you must manually change the flow control setting. Note that after calling BuildCommDCB(), you must still call SetCommState() to have the changes take effect.

```
BuildCommDCB("COM1:2400,
n,8,1",&dcb);
// Turn Software Flow
// Control On
dcb.fInX = TRUE;
dcb.fOutX = TRUE;
SetCommState(&dcb);
```

SENDING DATA Transmitting information is the heart of any communication program, and fortunately, calling the Windows functions used for transmitting information is a straightforward process. The primary function used for sending data is WriteComm(), whose syntax looks like this:

```
int WriteComm(idComDev,
lpvBuf, cbWrite)
```

WriteComm() requires three param-

ters: a device ID, a pointer to a block of data, and the number of bytes to write. The function doesn't send the data directly; rather, it places the data in the send queue. Windows monitors the send queue and sends the data based on the baud rate and flow control settings that you specified when configuring the device. WriteComm() returns immediately after moving the data into the queue without waiting for the data to be sent. A successful call to WriteComm() returns the number of bytes added to the send queue.

Data may still be in the send queue awaiting transmission when a subsequent WriteComm() call is made. If there is not enough free space in the queue to hold the additional data, Windows will return a negative value in the return code to indicate an error. The absolute value of the return code is the number of bytes that was actually added to the queue. A return value of zero indicates both that an error has occurred and that no bytes were added to the queue. In any event, whether or not an error occurred, the GetCommError() function will tell you how many characters are in the receive and send queues. The Windows SDK states that the WriteComm() function will delete data in the send queue if there is no room for additional data. This is simply incorrect. If you examine the communications driver code in the Windows DDK (Device Driver Kit), you'll see that instead of deleting data when the send queue is full, the communications driver returns a CE_TXFULL error. You can test this by calling the OpenComm() function with a very small send queue size and then deliberately trying to overrun the send queue. Windows will not delete data.

GetCommError() requires two parameters: a device ID and a pointer to a COMSTAT structure. The COMSTAT structure provides both current flow control information and the amount of data sitting in the send and receive queues. The GetCommError() return value indicates what caused the last communication error. If you care only about the return value, you can pass GetCommError() a NULL pointer in place of a pointer to a COMSTAT structure. GetCommError() fills the COMSTAT

structure with the number of bytes that is waiting in the send and receive queues. To calculate the number of free bytes, subtract the number of bytes in the write queue from the queue size you specified when you called OpenComm().

There are other errors that can occur when you call WriteComm(), and if an error does occur, Windows locks the device. This prevents any data from being

Receiving data is the most difficult part of Windows communications programming.

inserted or removed from the queues. A locked queue does *not* prevent new data from being received or data that is in the send queue from being sent, however. A locked queue only prevents the WriteComm() and ReadComm() functions from accessing the queues.

To unlock the queues, you must call the GetCommError() function. GetCommError() returns an error code that indicates the cause of the error. GetCommError() also acknowledges the error, which unlocks the queue and allows WriteComm() and ReadComm() to operate normally.

Note that the WriteComm() function can return *any* error, including errors that occurred before you attempted the WriteComm() call. The most likely error is a full send queue.

If your application requires sending special characters ahead of any data that is waiting in the send queue, you can call the TransmitCommChar() function. For example, if you press the Ctrl-S (XOFF) key combination, you will probably want this to be sent immediately. The TransmitCommChar() function places one character at a time at the beginning of the send queue.

Placing the special character at the head of the queue guarantees that that character will be the next one sent, but Windows does not guarantee that it will send the character immediately. If flow control or a communication error has disabled transmission, the character will not

be sent until transmission resumes. No additional characters can be transmitted using TransmitCommChar() until the previous special character has been sent. Thus, a subsequent call to TransmitCommChar() will return an error if the previous character is still waiting.

RECEIVING DATA Receiving data is the most difficult part of Windows communications programming. On the surface, calling ReadComm() appears to be almost exactly the same as calling WriteComm(). But calling ReadComm() is more complex. Your program must know when to call ReadComm(), and it must do so often enough to prevent the receive queue from overflowing.

There are basically two ways to determine when new data is available in the receive queue. One is to use the EnableCommNotification() function to have Windows notify your program. The other is to poll the queue periodically looking for the data.

EnableCommNotification() sends your application a WM_COMMNOTIFY message when data is received or transmitted, or when modem and line status events occur. Your program specifies the number of bytes that should generate the notification message. EnableCommNotification() makes your application a good Windows citizen by not wasting processor time polling for data.

The syntax for the EnableCommNotification() function is

```
BOOL EnableCommNotification
(idComDev, hwnd, cbWriteNotify,
cbOutQueue)
```

The first two parameters, a device ID and a window handle, are straightforward. The device ID is returned by an OpenComm() call, and hwnd is the handle of the window that should receive the WM_COMMNOTIFY message. The third parameter specifies how many bytes should be in the receive queue before the communications driver posts a WM_COMMNOTIFY message with a notification code of CN_RECEIVE to your window.

In practice, the cbWriteNotify parameter should be set to 1. If you set it to a value greater than 1, data can sit in the queue indefinitely. For example, if you

set it to 5 and only 4 bytes are received, you'll never be notified. To prevent the communications driver from posting a message on every received byte, Windows turns notification off until the queue drops below the notification setting that you specified in the `EnableCommNotification()` call—again, in this case, to 1 byte. A notification setting of 1 byte means that the queue must drop to 0 bytes for notification to be turned back on.

Additional characters will probably be received between the time Windows generates the notification message and the time you call `ReadComm()`. To ensure that you read all waiting characters and the receive queue drops below 1 byte, therefore, you should call `ReadComm()` repeatedly until Windows returns 0 as the number of bytes received.

The fourth parameter, `cbOutQueue`, specifies the number of bytes that should be in the send queue before Windows generates a notification. When the number of bytes falls below this number, Windows generates a `WM_COMMNOTIFY` message with a `CN_TRANSMIT` parameter.

For terminal-oriented communications, this notification can be turned off by specifying a notify value of -1. It's unlikely that anyone can type at a terminal faster than the data can be sent. Write notification isn't usually needed because the send queue doesn't usually remain full for very long. In any case, it's easy to adjust to `WriteComm()` errors.

`EnableCommNotification()` is also useful for other notifications, such as being notified when there is an incoming call—the equivalent of a phone ringing. The `SetCommEventMask()` function controls the type of line status and modem status events that will generate a `WM_COMMNOTIFY` message. The *Microsoft Windows Software Development Kit Reference* contains a listing of event types with the documentation for `SetCommEventMask()`. You can query the current event mask by calling `GetCommEventMask()`. The mask will always be zero until you call `SetCommEventMask()` to change it.

The alternative to using the `EnableCommNotification()` function is to poll for data. One reason why you might pre-

fer not to use `EnableCommNotification()` is to preserve backward compatibility with Windows 3.0. There are two commonly used polling methods. The first and simplest method is to add code in the message loop that polls for characters as part of polling for messages. This method is the easiest to write, and it also gives highest priority to received data. The message loop runs so often that anything in it will implicitly have a high priority. Other polling methods rely on low priority events, such as a Windows timer.

The downside to using message loop polling is that it is very inefficient, since your program checks for new data even when there is no data to receive. The cost in processor cycles of checking is the same whether your program finds data or not. By using `EnableCommNotification()`, your program checks for data only when it knows the data is there.

To implement message loop polling, there are a couple of changes your program will need. The first change is to replace a call to `GetMessage` with a `PeekMessage` call. This change allows your program to check for received data even if there are no messages waiting in the message queue. The second change is to add a `ReadComm()` call after the `PeekMessage` call. The following example shows how the new message queue should appear after the changes:

```
while(PeekMessage(&msg, NULL, NULL,
NULL, PM_REMOVE) && msg.message
!= WM_QUIT) {
    if((cbBytesRead = ReadComm(idComm,
&achBuf, sizeof(achBuf))) > 0) {
        // Data Received - Process Data
        ...
    }

    TranslateMessage(&msg);
    DispatchMessage(&msg);
}
```

After a successful `ReadComm()` call, your program can perform any processing of the data directly from the message loop. Typically, a program will display the data. Although the Windows SDK recommends displaying data only when you receive a `WM_PAINT` message, GDI functions such as `TextOut` are fast

enough that you can probably call them from the message loop.

It is important, however, that your program not interfere with the performance of other programs. If processing the data will be time-consuming, therefore, your application has a responsibility to break up the processing in order to al-

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low other applications to run. One way to do this is to post yourself one or more private messages and process the data from your application's window procedure. Remember that after you receive data, you must still process the messages that you retrieved from the `PeekMessage` call.

An alternative to message loop polling is to use a Windows timer. A timer provides your program with a "heartbeat" it can use to poll regularly for new data. To set the timer, you call the Windows `SetTimer` function. It's important that the time interval is set to activate sufficiently often to provide your program good response time. Four times a second (250 milliseconds) is an appropriate value for most applications. You can increase or decrease this value depending on your application's needs.

The primary advantage of using the timer polling method is efficiency. The timer method's primary disadvantage is that timer messages have a low priority and are posted to your program only when there are no other messages to process. Another possible problem is if all of the timers are already in use, your program may not be able to set a timer! In practice, however, I have yet to encounter this particular problem. Thus, because the load placed on Windows is significantly lower, you should use the timer method for polling when you don't

have to poll too frequently and when the polling is not time-sensitive.

HARDWARE CONTROL Windows does a reasonably good job of shielding applications from the communications hardware and of handling flow control. Despite this, however, programs that are ported from DOS tend to be hardware-specific, so your program may need to access the communications hardware directly.

A common misunderstanding about the DCB structure modem status fields is that they provide direct hardware control by themselves. This is a mistake. The DCB fields tell Windows how you want Windows to control the hardware. If you want direct control of the hardware, you must call `EscapeCommFunction()`. This will allow you to set the modem status registers in the UART.

Your program can use the `EscapeCommFunction()` with either the `SETXON` or `SETXOFF` flags to change the software flow control. Calling `EscapeCommFunction()` with either of these flags overrides the state currently being maintained by Windows. Hardware flow control lines are similarly set by using the `SETDTR`, `CLRDTR`, `SETRTS`, or `CLRRTS` flags.

The `EscapeCommFunction()` has one additional flag, `GETBASEIRQ`, that is documented in the Windows 3.1 Device Driver Kit (DDK) and also in `WINDOWS.H`. The `GETBASEIRQ` flag causes Windows to return a `LONG` value that has the base hardware port of the communication processor in the low word and the IRQ address in the high word. For example, COM1 will normally return 0x3F8 in the low word and 0x4 in the high word.

HARDWARE STATUS The Windows SDK doesn't document a way to query the line status and modem status bytes in the communication processor. The `GetCommState()` function would seem able to do the job, but `GetCommState()` just returns a copy of the DCB structure. This structure is updated only when a `SetCommState()` call is made, and so it doesn't always reflect the physical state of the communications device. To get the physical hardware state, you must read other structures that are documented only in the Windows DDK.

Thus, to determine the modem status,

■ The DCB Structure

This sidebar provides a quick reference to the fields in the DCB structure. At least half of the DCB structure fields are used for flow control. The Windows SDK does a poor job of explaining how the flow control fields should be used. I have provided descriptions below for each of the flow control fields that should make them easier to understand. The flow control fields are shaded yellow. The other DCB fields also have simpler descriptions with information that is sometimes missing from the Windows SDK. —Mark Douglas

FIELD	DESCRIPTION
ID	BYTE Specifies the communications device identifier. This value is returned by the OpenComm() function.
BaudRate	UINT Specifies the baud rate at which the communications device should operate. The value is specified as an integer in bits per second (for example, 9600) or as one of the following flags: CBR_110 CBR_4800 CBR_56000 CBR_300 CBR_9600 CBR_128000 CBR_600 CBR_14400 CBR_256000 CBR_1200 CBR_19200 CBR_2400 CBR_38400 You must use the flags for baud rate settings above 56K because the UINT size of this cannot hold any higher integer values. The standard Windows communications driver does not support the CBR_256000 flag because the NS8250 communication processor (UART) family doesn't support it.
ByteSize	BYTE Specifies the number of bits in each byte sent to a remote computer. This value must be set to match the system with which you are communicating. The SDK says that possible values are 4 through 8. However, the NS8250 communication processor (UART) family supports only byte lengths of 5 to 8 bits. The most common value for PC-to-PC communication is 8, so that PC graphics characters and binary data can be sent.
Parity	BYTE Specifies the type of parity checking. Parity checking is a simple way of verifying that data has been transmitted correctly. Possible values are NOPARITY, EVENPARITY, ODDPARITY, and MARKPARITY. This value must match the application with which you are communicating. Parity checking is a fairly ineffective way to check for accurate transmission, however, and the parity bit constitutes overhead that requires an additional bit to be sent for every transmitted byte. For 8-bit bytes, the parity bit becomes 11 percent of the data sent. Therefore, this value is usually set to NOPARITY.
StopBits	BYTE Specifies the number of stop bits. Stop bits tell the communication processor where the end of a byte is. This value must match the application with which you are communicating. Possible values are ONESTOPBIT, ONESSTOPBIT, and TWOSTOPBITS. This value is almost always set to ONESTOPBIT, however, because the NS8250 family of communication processors checks for only a single stop bit even if the processor is set to 1.5 stop bits or 2 stop bits.
RlsTimeout	UINT Specifies the Receive Line Signal Detect (RLSD) time-out. This is also known as the Data Carrier Detect (DCD). A Hayes-compatible modem sets this field to indicate that it has an active connection with another modem. If you set this time-out, after the connection has been made, you can detect that the call has been dropped. Because the modem will keep this line on as long as there is an active call, you can set this field to a short time-out (under a second).
CtsTimeout	UINT This field specifies how many milliseconds Windows should wait for the application with which you are communicating to say that it is ready to receive data (Clear to Send). The Clear to Send line is used as part of hardware flow control. This time-out is automatically reset every time Windows is ready to transmit a character. If your application requires hardware flow control, you should set the time-out to a value other than 0. The value should be set for the maximum amount of time you think the recipient will take to process data. One rule of thumb is the amount of time it takes to write 32K to a floppy disk. If the CTS time-out expires, you can assume the modem or computer with which you are communicating has disconnected.
DsrTimeout	UINT This field specifies how many milliseconds Windows should wait for the application with which you are communicating to let you know it is ready to communicate. The Data Set Ready (DSR) line is usually on at all times you are connected to a modem or to any other physically attached device. This time-out value can be used to tell when the connection has been lost. If the time-out period expires, you can make the assumption that the communications device has disconnected. Because the DSR line is on constantly, you can set the time-out to a relatively short value (under 1 second). You can also set the value of DsrTimeout to 0 if you want to ignore it.
fBinary	UINT This field tells Windows to check for the character specified by the EofChar field (in the DCB structure) when receiving data. If the EofChar character is received, Windows sets the CSTF_FLAG in the COMSTAT structure.

fRtsDisable	UINT	When this field is TRUE, Windows turns on the Request To Send (RTS) line. Setting this field to FALSE does not turn the RTS line off. Regardless of how you set this field, the RTS line is always turned off when you close the communications device. By convention, you should normally set this field to TRUE regardless of whether you are using hardware flow control.
fParity	UINT	The fParity field specifies whether the communications driver should check for parity errors. But this field does not determine whether or not parity bits are actually used. It determines only if they should be checked when they are used. It is the Parity field that controls how parity should be used. The fParity field is normally set to FALSE. Error-correcting file-transfer protocols such as XMODEM use a more sophisticated error check procedure than parity checking.
fOutxCtsFlow	UINT	This field specifies whether hardware flow control should be used to send data. The Clear To Send (CTS) line is normally used for hardware flow control. If you want hardware flow control turned on, you should set this field to TRUE. If you set this field to TRUE, you should also set the CtsTimeout field.
fOutxDsrFlow	UINT	This field specifies whether the Data Set Ready (DSR) line should be used for hardware flow control. The DSR line is normally kept on at all times by most modems and communication software and therefore isn't normally used for hardware flow control. The DSR line is used to know that the modem or computer with which you are communicating is still attached, since if they become disconnected, the DSR line will turn off. Set this field to TRUE if you want Windows to check the DSR line before it transmits a byte. If you set this field to TRUE, you should also set the DsrTimeout.
fDtrDisable	UINT	When this field is TRUE, Windows turns on the Data Terminal Ready (DTR) line. Setting this field to FALSE does not turn the DTR line off. Regardless of how you set this field, the DTR line is always turned off when you close the communications device. By convention, you should normally set this field to TRUE.
fOutX	UINT	Specifies whether software flow control should be used when sending data. If this field is set to TRUE, transmission stops when the XoffChar character is received and starts again when the XonChar character is received. You should set this field to TRUE for software flow control.
fInX	UINT	Specifies whether software flow control should be used when receiving data. If this field is set to TRUE, the XonChar character is sent when the reception queue comes within XoffLim characters of being full, and the XonChar character is sent when the reception queue comes within XonLim characters of being empty. You should set this field to TRUE for software flow control.
fPeChar	UINT	Specifies whether the character in the DCB field, PeChar, should be substituted for characters received with parity errors. This field should be set to TRUE if you enable parity checking and want to be able to look for the PeChar after each ReadComm() call. This field can be ignored if fParity is set to FALSE.
fNull	UINT	Specifies that received null (0x00) characters are to be discarded.
fChEvt	UINT	Specifies that the reception of a character defined by the DCB field EvtChar is to be flagged as an event. SetCommEventMask() must also be called to enable the event.
fDtrflow	UINT	Specifies that the DTR (Data Terminal Ready) line is to be used for reception flow control. The DTR line is not normally used for flow control. This field is normally set to FALSE.
fRtsflow	UINT	This field specifies that the Request to Send (RTS) line is to be used for reception flow control. You should set this field to TRUE if you want hardware flow control.
XonChar	char	Specifies the value of the XON character for both transmission and reception. This field should normally be set to 0x13 if either of the DCB fields, fOutX or fInX, is set to TRUE.
XoffChar	char	Specifies the value of the XOFF character for both transmission and reception. This field should be set to 0x11 if either of the DCB fields, fOutX or fInX, is set to TRUE.
XonLim	UINT	Specifies the minimum number of characters allowed in the reception queue before the XON character is sent. This field is set in bytes. A reasonable value is 20 percent of the size of the receive queue.
XoffLim	UINT	Specifies the maximum number of characters allowed in the receive queue before the XOFF character is sent. This field is set in bytes. A reasonable value is 1 second of data. At 9,600 bps, this value would be 1,200 bytes.
PeChar	char	Specifies the substitution character for parity errors. If the DCB field fPeChar is set to TRUE, this character is placed in the receive queue when a parity error occurs, replacing the character that was received. If either the fParity or fPeChar field is FALSE, this field is ignored.
EofChar	char	Specifies the character that is used to signal the end of data. If the fBinary field is TRUE, this field is ignored.
EvtChar	char	Specifies the character that is used to signal an event. If the fChEvt field is FALSE, this field is ignored.

Note: The fDummy, fDummy2, and TxDelay fields in the DCB structure are ignored by the communications driver.

you must access a data structure outside the Windows SDK. Specifically, this structure is the Communication Device Equipment Block (COMDEB). The COMDEB structure is documented in the communications driver code in the Windows Device Driver Kit.

The COMDEB structure is a superset of the DCB structure that holds device-specific information for a communications device. This information includes queue sizes, an event mask, and—the information you're really after—the modem status.

The relevant COMDEB field is called the Modem Status Register Shadow (MSRShadow). This is an 8-bit field that holds the current modem status reported by the National Semiconductor NS8250 UART family of communication processors. The trick of getting the modem status, then, is to get access to the MSRShadow.

The value returned by the SetCommEventMask() function is a pointer to an event mask, and it provides backdoor access to the MSRShadow. The event mask is also a member of the COMDEB structure, so the pointer can be used to access other fields as well. Once you have this pointer, all you have to do is adjust it to point to the MSRShadow field instead of to the event mask field. As it happens, the MSRShadow field is located some 35 bytes beyond the event mask. The following example shows how to use the SetCommEventMask() function to get access to the MSRShadow:

```
BYTE    tMsrShadow;
tMSRShadow =
*((LPBYTE)SetCommEventMask(idCom,
NULL) + 35);
```

As with any device driver structure, there's a chance that the COMDEB structure may be changed or eliminated. Microsoft Corp. has indicated, however, that any COMDEB changes in future versions of Windows will either maintain the current location of the MSRShadow or provide a function that carries the equivalent information. Windows NT, in fact, provides just such a function.

ADDITIONAL FUNCTIONS Closing the communications device relinquishes control over the device. CloseComm() will

also hang up the phone, depending on how you set the `fDtrDisable` field of the DCB structure. When the `fDtrDisable` field is set to `FALSE`, the `CloseComm()` function clears the DTR signal, which hangs up the phone. Note that the `EscapeCommFunction()` function can also clear the DTR signal.

You must ensure that the DTR signal is cleared by one of these two methods, or your phone call will remain active indefinitely, even after the device has been closed. Setting the `fDtrDisable` field to `FALSE` is an easy way to ensure that this doesn't happen.

Four other functions round out the Windows communications API. These functions are `FlushComm()`, `SetCommBreak()`, `ClearCommBreak()`, and `UngetCommChar()`.

The `FlushComm()` function empties either the read or the write queue. The function accepts two parameters: a device ID and a second parameter that identifies which queue to empty (1 for the read queue, 0 for the write queue). Note that flushing the write queue does not send the data in the queue. Flushed data is discarded.

The `SetCommBreak()` and `ClearCommBreak()` functions respectively set and clear the break state of the communications device. Windows automatically suspends data transmission after a call to `SetCommBreak()` and restores data transmission after `ClearCommBreak()` is called to turn off the break state.

`UngetCommChar()` is an unusual function that places a character at the beginning of the receive queue. This character will thus be the first character returned the next time you call `ReadComm()`. The `ReadComm()` function must be called between successive calls to `UngetCommChar()`; if you attempt to call `UngetCommChar()` twice without calling `ReadComm()`, the second call will fail.

Windows 3.1 provides greater support for modem communications. The information in this article furnishes the support to make your Windows communications programming an easier task. □

MARK DOUGLAS IS PRESIDENT OF INTOUCH SOFTWARE INC., WHICH DEVELOPS WINDOWS COMMUNICATION SOFTWARE.

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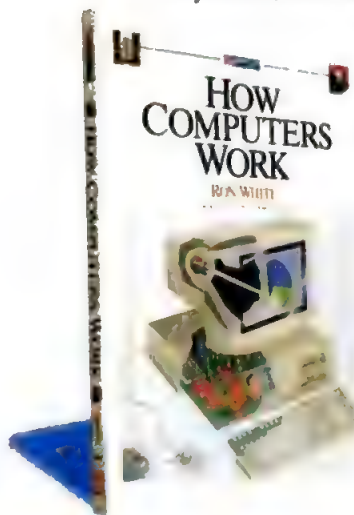
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Catalog Your Windows Fonts With FNTPRN

BY JOHN DEURBROUCK

F

inding the font you want can be frustrating. Remembering the difference between Times New Roman and Arial may be easy, but what does Bembo look like? Does Garamond have an attractive, true italic? And which font is the one that looks like the type that appears on an Old West Wanted poster?

Font selection dialog boxes—for example, the one that pops up when you select CharacterFonts in Windows Write—show you fonts, but only one at a time. That gives you some nice confirmation of what you already know, but it's too slow and cumbersome if you need to search for or browse among more than a few fonts.

FNTPRN, this issue's utility, gives you a way to view multiple fonts. You can download a copy of the program and its source code from the Utilities/Tips Forum on PC MagNet, archived as FNTPRN.ZIP. (See the sidebar "Utilities by Modem" for instructions.) You can also obtain the files by sending a postcard with your name, address, and disk preference to the attention of Katherine West, *PC Magazine*, One Park Ave., New York, NY 10016-5802, or by faxing your request to 212-503-5799. No phone calls, please.

To compile the source code, you'll need Borland's C++ 3.1 or Microsoft's C/C++ 7.0. FNTPRN requires Version 3.1 of Windows because it employs programming features found only in this release. The utility works with all of Windows' native fonts as well as any Microsoft TrueType and Adobe ATM fonts.

ABOUT FACES A *typeface* (in Windows—typographers employ a stricter definition) is the name given to the design of a set of characters. Individual variations of a typeface—known as *fonts*—are

described by three parameters: point size, weight, and degree of slant. The first, *point size*, measured in a unit called the *point* ($\frac{1}{72}$ of an inch), gives the vertical distance of an imaginary rectangle that surrounds each character of a font. Be careful to distinguish between this and *height*, as it is used to describe the distance from the bottom of a font's *descenders* (the tail in a lowercase y, for instance) to the top of its *ascenders* (the uppermost point on a lowercase f, for example). Height can—at a maximum—match the point size but rarely does, since a character seldom occupies the entire

*Produce your own font
reference with this
Windows Write-file
generator.*

vertical dimension of its invisible box.

The other two factors that separate fonts from one another are *weight* (bold, for instance) and degree of slant (italic, none, or oblique). (The combination of weight and slant is known as the font's *style*—bold-italic is one example, bold by itself is another.) Thus Arial (the TrueType Helvetica clone) is a single typeface and the following describes four of its fonts: 8-point Arial, 10-point Arial, 8-point Arial italic, and 8-point Arial bold.

Windows assigns typefaces—based on their general appearance—to one of five groups called *families*. Typefaces suggestive of cursive writing fall into the Script family, while those with ornate designs are classified as Decorative. Of the remainder, most with constant-thickness *strokes* (the lines composing each character) are considered Modern (Courier, for

one), while those with variable strokes land in the Roman family if they contain *serifs* (short, decorative strokes such as those hanging off the top of this T) or the Swiss category if they are *sans serif* (such as Arial or Helvetica). Fixed-pitch or monospaced fonts use the same amount of space for every character, while *variable-pitch* or *proportional* fonts use more space for larger characters. Monospaced fonts line up nicely into columns, while proportional fonts are more compact and easier to read. Finally, Windows actually contains a sixth font family known as Dontcare (labeled as Other in FNTPRN's Option window), which lets a program select a font without regard to the family.

There are several technologies used to create fonts in Windows, but all fall into one of two general categories: *bitmapped* and *vector*. A *bitmapped* font is essentially a dot-by-dot description of every character. They're fast, but they don't *scale* (change size) well—printing an 8-point bitmapped font at 24 points yields a chunky, unattractive result. *Vector* fonts include stroke fonts, ATM, and TrueType. Instead of being a collection of dots, vector fonts are descriptions of each character: a line here, a curve there. Thus vector fonts scale well and look good at any size. *Stroke* fonts are an older technology, included mainly for printing on plotters. *ATM* (Adobe Type Manager) fonts are designed to work at any point size on both the screen and any Windows printer. ATM fonts can be particularly fast with PostScript printers. *TrueType* fonts were introduced to Windows in Version 3.1 and offer scalability like ATM fonts.

INSTALLING AND DELETING FNTPRN The utility demands no special effort to install. To place its icon in the currently selected program group, use the Program

Manager command File | New, choose Program Item from the dialog box, and after clicking OK, fill in the blanks in the Program Item Properties dialog that comes up, then choose OK once more.

Removing FNTPRN takes as little effort. Dispose of its icon by selecting it and choosing File | Delete from the Program Manager menu. Repeat the procedure for all occurrences of the icon, then erase FNTPRN.EXE. The program makes no modifications to WIN.INI, and the only files it creates are .WRI files containing font examples.

USING FNTPRN If you're in a hurry, you can use FNTPRN without installing it simply by selecting File | Run from the Program Manager menu and entering the utility's full pathname in the resulting dialog box, which brings up the FNTPRN window. Set the options you want, make sure that the Launch Write check box in

the lower-left corner is checked (if it isn't, click on it), then click the OK button. You'll be presented with a standard Save As dialog box (but with a title bar that reads "Choose Output Filename"). After you pick an output filename, select OK again. FNTPRN will generate and save a sample file based on the options you selected, then display it in Windows Write. (If you don't make any changes and then click on OK, a file named FNTPRN.WRI will be saved to the directory that contains FNTPRN.) FNTPRN is still running, so you can switch to it while Write is still running or after you're done, where you can design another report or quit the utility. That's the quick start. Now for a few details.

■ Utilities by Modem

The *PC Magazine* utilities are available by modem from PC MagNet, a ZiffNet service hosted by CompuServe.

To find the phone number nearest you, set your communications software to 300, 1,200, 2,400, or 9,600 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex, then dial 800-346-3247 with your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the number closest to you. Or you can call 800-635-6225 (voice) and follow the instructions and note the number.

To obtain the current issue's utility free of charge: Dial the local number; at the HOST NAME prompt, type CIS; and at the USER ID prompt, enter 60116.1. Then at the PASSWORD prompt, enter PCMAG UTIL.

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ZiffNet membership costs \$2.50 per month. This includes access to *PC Magazine* Editors' Choice awards, Product Reviews Index, Weekly News from *PC Week*, Buyers' Market, ZiffNet Highlights, and the Support Forum (which also includes the current utility). CompuServe members can join by entering GO PCMAG at any CompuServe ! prompt.

Outside of these areas, PC MagNet costs \$6.30 per hour for 300-bps service; \$12.80 for 1,200 or 2,400 bps; and \$22.80 for 9,600 bps. Billing is based on 1-minute increments.

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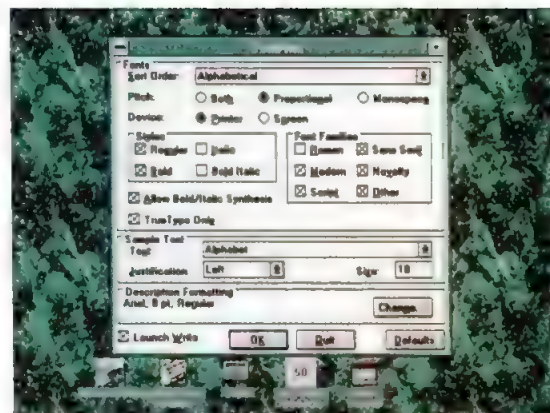


Figure 1: This issue's utility, FNTPRN, creates a Windows Write file showing the fonts in your system designated in this window.

Running FNTPRN takes you right to the heart of the program—its option window, which is shown in Figure 1. Most items on this screen fall into one of three option groups—Fonts, Sample Text, and Description Formatting.

The Fonts section allows you to configure the report file FNTPRN produces. Sort Order (covered in greater detail shortly) is a drop-down list used to determine the sequence of samples in the output, while the Pitch radio buttons let you include proportional fonts, monospace, or both, and the Device selection determines whether the file will contain printer or screen fonts. The output will incorporate whatever selections you make under the Font Families and Styles categories, but you must select at least one of each. If you check the check box labeled Allow Bold/Italic Synthesis, and if a particular typeface lacks any or all of the styles (italic, bold, or bold-italic), FNTPRN will request that Windows artificially create those you've included. (Some limits, which I'll describe a little later, exist.) Check the TrueType Only checkbox to restrict the report's contents to just those fonts. You may want to do this to exclude clunky, nonscalable fonts (such as LinePrinter) from your report. Don't check the box, though, if you use ATM fonts. Let your font collection be your guide!

If you make no changes in the Font section's options, they default to alphabetical sort order, both spacing types, printer fonts, all styles and families, bold/italic synthesis, and any make of font (rather than TrueType alone).

As implied above, Sort Order presents you with several choices. The first—Alphabetical—sorts by face name, so Arial would come before Bodoni Bold. To arrange the report by height (as defined near the beginning of the article) choose that item from the list. Width refers to the average width of the characters in the font, while Proportion sorts by the result of height divided by width, so tall, skinny fonts would come before short, squat ones. Weight orders the output by the boldness designation the vendor supplies, thus lighter fonts will precede darker ones. Font Family organizes the report alphabetically by the vendor-provided font family information and can help you zero in on a desired look quickly.

Earlier I indicated that sometimes—but not always—Windows can artificially create styles not provided with a particular font. I have an Arial MT, for example, that comes only in regular, but Windows can easily widen the strokes to fake a bold look, slant them so they seem italicized, or combine both processes to give the characters a bold-italic appearance. Choosing to include these styles and selecting Allow Bold/Italic Synthesis will make them appear in FNTPRN's report. On the other hand, the Bodoni I use just offers a bold. Windows can make a bold-italic, but it can't thin out the strokes to imitate a regular or regular-italic—so allowing synthesis will do no good for those two styles.

SAMPLE TEXT The Text drop-down list in this section of FNTPRN's screen lets you display each of your chosen fonts using one of four sample texts. The first se-

lection prints exactly the characters it displays, chosen for their ability to show off most features of the font without taking a lot of room. Use Text Paragraph to get a better idea of how a large block of text will look and Alphabet to see all the upper- and lowercase characters, 0 through 9, and the symbols contained on IBM-compatible keyboards. The Sample Text-list item simply prints the phrase "Sample Text," but for a specific purpose. FNTPRN supplies no direct way that you can enter your own example text. To use your own choice of text, use Write's search-and-replace to substitute it for Sample Text.

Justification of text sets the spacing between words and controls where each line is placed relative to the left and right margins. FNTPRN presents the four possibilities via a drop-down list. Center places the middle of the text line halfway between the margins, dividing any remaining space (which can vary from line to line) equally and putting it at the ends. Justified adjusts the distance between each word so that unindented lines—except, possibly, the last in a paragraph—stretch to the margins. This column is an example. Left forces every line against the left margin, pushing any extra space—which, again, can vary—to the other end. The uneven line endings give that side of the page a ragged appearance, so this is also known as ragged right. As you might guess, Right (or ragged left), does just the reverse, pushing lines against the right margin.

To select the point size for your chosen sample text, enter any value from 6 to 72 in the Size box. 10 is a good choice for viewing fonts that you plan to use in the body of your writing. However, if you want to get a good look at candidates for headlines and decorative text, you should try a setting of 36. A little experimentation will quickly give you a feel for what to pick.

The default Sample Text options are the sample list's first item, left justified at 18 points.

DESCRIPTION **FORMATTING** FNTPRN labels each sample on its output using the font displayed under Description For-

matting. To make modifications, click the Change button to bring up a standard font-selection dialog box. Make your selections from the scroll lists presented or type your choices in and click OK when finished. Your changes will be reflected in the Description Formatting area. The default is 8-point Arial Regular.

The Launch Write check box, at the bottom left of the window, lies outside any option group. If checked (as it is unless changed), FNTPRN first follows its normal procedure when you click OK. It asks for a filename and, assuming you select OK again, creates and immediately saves its report to the .WRI file you specify. After, however, it also launches Microsoft Write, loading the newly generated report into it. If you would rather view the file later, remove the x from this option's check box. Now selecting OK from the program's window (and again from the Choose Output Filename dialog box that appears) saves the .WRI file but doesn't start Write.

The Defaults button restores each control to the state it was in when you first started the utility, and, as you have seen, clicking OK produces the output file and loads it into Write. Press Cancel in the Choose Output Filename dialog to return to FNTPRN's main window without generating the font document.

FNTPRN's REPORT FNTPRN produces easily understood output, as Figure 2 shows. An informational header at the top serves as a reminder of the choices you made to generate the report. The "Number of Font Families Found" appears first, then a list of included font families (Roman, modern, sans serif, script, novelty, and unknown), followed by your selections for Device (screen or printer), "Synthetic Bold/Ital allowed," Styles (any combination of regular, bold, italic, and bold-italic), "Sort Order," and "TrueType only" (if you made that restriction).

The styles for each typeface appear as a group, so the figure shows the sample paragraphs for Arial together, in the order regular, bold, italic, and bold-italic. A line of description follows each and displays the font's name as provided by the manufacturer, the style, its spacing type (monospaced or proportional), the family, and if the font is TrueType or not—

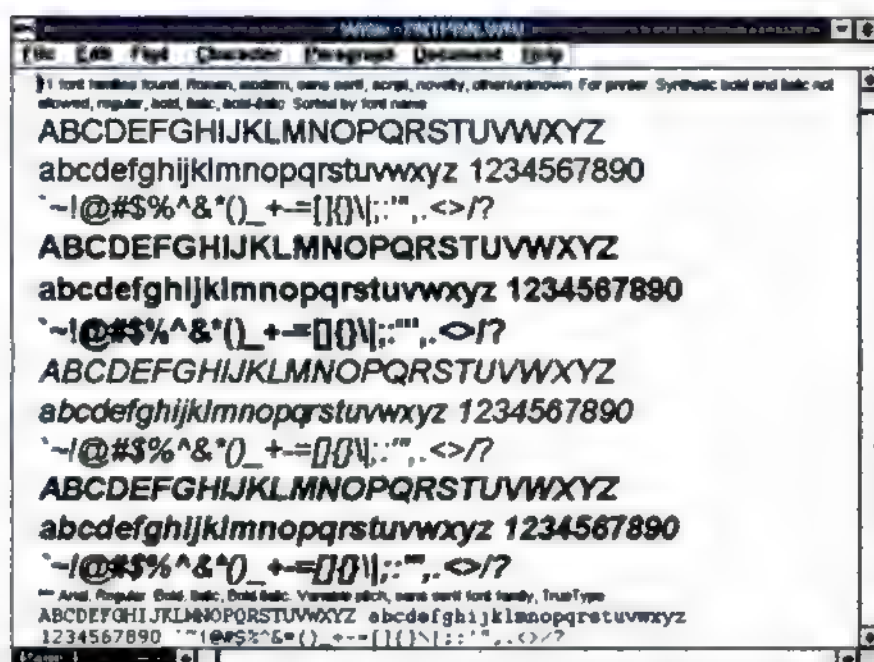


Figure 2: A sample of FNTPRN's output, showing the informational header, fonts, and descriptions following the fonts.

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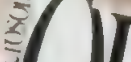
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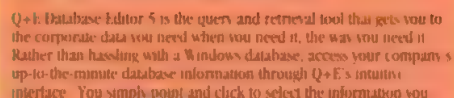
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FNTPRN.C

Partial Listing

```
PostMessage(hwnd, WM_COMMAND, IDD_GETGOING, 0L);
ShowWindow(hwnd, nCmdShow);
while (GetMessage(&msg, NULL, 0, 0)) {
    if ((msg.message == WM_KEYDOWN & msg.wParam == VK_ESCAPE) ||
        (!IsDialogMessage(hwnd, &msg))) {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
    }
}
```



Figure 3: This code initializes the dialog box and dispatches messages for FNTPRN.

with all items separated by commas. Any synthesized styles will be described that way—*Synthesized Bold*, for example.

You may notice some font names repeated. Courier shows up several times on my own system. This is because Windows actually allows the same name for multiple fonts. If the fonts are in different families, FNTPRN, Windows, and Write will distinguish among them correctly, so don't worry about duplicates in FNTPRN's report. If duplicates are in the same family, you'll see only one—the one Windows chooses—both on-screen and on the printer. Windows will choose the best version for each purpose.

Some fonts, such as System (which is fixed-width and comes with Windows), are meant exclusively for screen display and can't be printed exactly. Others—LinePrinter on my laser printer, for instance—correctly reproduce on paper only. Since Write can both display and print files, FNTPRN's use of it gives you at least one way to see any font as it truly looks. Remember, though, when no font exists for a device, Windows substitutes something close—so you'll still see a representation, but not necessarily an accurate one.

If your default printer is a PostScript device, certain fonts may not display or print correctly—whether you are using FNTPRN or some other application. For example, rather than Wingdings, you may get the native Symbols font. To correct the problem, open Control panel and select Printers | Setup | Options | Advanced. If "Use Printer Fonts for all TrueType Fonts" is checked, you're gaining speed but losing most of your TrueType fonts (Wingdings, for example). Uncheck this box and you'll be able to access your TrueType fonts again.

EXPLORING YOUR FONTS

Printed font catalogs are handy. If you use a lot of decorative faces, why not create a set of all your fonts at about 36-point size? Leafing through it from time to time will help you remember what you have.

FNTPRN's Write files are compact, so leaving them on-disk is fine. Since they're ordinary .WRI files, you can edit them, use search-and-replace, and perform any other function possible on a typical Write document. This also ensures that they import well into most Windows word processors.

Suppose you produce a newsletter and want to see how a paragraph of text might look in all of your Roman fonts. Generate a font list with FNTPRN, then import the file into your word processor and set your page format to three columns. A few cautions are in order. First, working in a word processor with FNTPRN's .WRI files can be rather slow. Nearly every line uses a new font, so the computing overhead can be high. Turn on your draft mode to save time until you want to look at the actual fonts.

Though FNTPRN uses vendor-supplied information to produce its reports, not all font publishers provide accurate data. One simply reports every family as Unknown—even Times Roman and Helvetica clones, lumping them together with map symbols and script fonts. FNTPRN would be a mammoth program if it tried to distinguish these characteristics on its own, so its sorting ability is at the mercy of the font makers.

I also ran across a limitation in Write. Though its file format supports up to 512 fonts per document, the program itself fails to handle more than about 60 correctly. As soon as it gets past its limit, Write starts using fonts from the beginning of its list over again, so your last font may be labeled Times New Roman but show up as Arial. This won't hurt your system, but you won't get an accurate rendering of your fonts. If this is a concern for you, you'll need to use another

tool to look at FNTPRN's output (Win-Word works fine).

Careful use of fonts can make the pages you produce more effective. FNTPRN can help you use your fonts better than ever before.

PROGRAMMING CONSIDERATIONS

I wrote FNTPRN in C (medium memory model) using C++ 3.1 and the EasyWin library, both from Borland. Since the library made it almost effortless to develop FNTPRN incrementally, I decided to leave the test code in the source for you to examine. EasyWin is the only compiler-specific aspect of FNTPRN, though, and is only used when making a test version of ENUMFONT.C. The production version of FNTPRN can be built with either the Borland or the Microsoft compiler. In either environment (BCW or PWB), use the project manager to select FNTPRN.C, FNTPRN.RC, and FNTPRN.DEF. For the Microsoft compiler, you'll have to add the COMMDLG.LIB import library for ChooseFont() and GetOpenFileName(). Set the compiler to produce a Windows executable, and you will generate FNTPRN.EXE.

FNTPRN needed to perform some fairly sophisticated data manipulation, so

*Using the EasyWin library
to build test scaffolding made
it almost effortless to develop
FNTPRN incrementally.*

I spent my time there and used an existing Windows program—Write—as a tool for the reporting feature. Write handles the display and printer and also allows editing of the final report. Working with an existing application saved code, programming time, and end-user disk space.

FNTPRN starts by displaying a dialog box for its main window, as the code in Figure 3 shows. IDD_GETGOING is posted to the dialog box and the WM_COMMAND message is used to initialize all of its child windows. Why isn't this done during processing of the WM_INITDIALOG message? Because at the time WndProc() gets that message,

the child windows have not yet been created. The `PostMessage()` call allows initialization to proceed.

The fourth and fifth lines provide a call to `IsDialogMessage()`, which most dialog boxes need so that the Tab, arrow, and Alt keys can move the input focus from control to control. Generally, dialog boxes are temporary displays, so Windows makes it easy to close them by simply pressing the Esc key. FNTPRN's dialog box is its main window, though, so I chose not to allow such a precipitous exit. Why not simply trap `WM_KEYDOWN` messages in `Wnd Proc()`? Because `IsDialogMessage()` picks them off right there in the message loop. The test on line 4 prevents `IsDialogMessage()` from processing `WM_KEYDOWN` messages for the escape key.

Having displayed the dialog box, FNTPRN waits for the user's order before producing the requested file. The `generate_file_from_options()` function in `ENUMFONT.C` (shown in Figure 4) performs that task and shows the steps necessary to accommodate the user's request. Global variables are initialized, font data is gathered and sorted, the report is generated, the user chooses an output filename, the output file is written, and the cleanup work is done.

The `gather_data()` function acquires all font data. The code calls `EnumFontFamilies()`, passing it a callback function, and Windows calls the callback function once for each font in the specified family. The callback function is `families()`, which calls `EnumFontFamilies()` again for each font family. The callback function for this second invocation is `individuals()`, which gathers data on each style present for a given font. If TrueType fonts only are specified, font data is not stored for bitmap, stroke, and ATM fonts. This con-

serves space in our 512-entry fonts array.

Information on each font is stored in a `TRACKFONT` structure, shown in Figure 4, kept in memory obtained from `GlobalAlloc()` through the `get_memory()` suballocator. A local array (called fonts) of far pointers to `TRACKFONT` structures is used rather than a linked list, which allows use of the `qsort()` runtime library function. The fixed size of the array isn't a problem, since the .WRI file format doesn't allow more than 512 fonts anyway.

Putting the font data in order is simple. Using the runtime library's `qsort()` function, you need only provide a comparison function to sort the array of pointers to stored font data.

Volume 4 of the Windows 3.1 SDK documents the write file format. It consists of a header, the text, character, and paragraph formatting information, a page table, and font face names. FNTPRN uses the `WRITEFILE-HEADER`, `FOD`, `PAP`, `CHP3`, and `CHP5` structures to create the pages that make up a Write file. `ENUMFONT.C` defines the structures, which are simple transcriptions of those in the Windows SDK and discussed extensively there.

Before it's written to disk, the Write file is completely built in memory. This lets you avoid calling `lseek()` to rewrite the first sector, which contains information unavailable until all the sections of the file have been constructed. For example, the `fcMac` element of the file's header is a count of the number of bytes in the text portion of the file.

The `write_data_file()` function actually writes the output file to disk. This function first writes the header, then traverses the `text_first`, `char_first`, `graf_first`, and `font_first` linked lists to write the complete data file. Prebuilding the data file in memory, along with gathering only information that doesn't require actually loading font files, helps to make FNTPRN fast.

The only user interaction that takes place in `ENUMFONT.C` is the displaying of the Save As common dialog box. I wanted the report generation to finish before asking for the filename, and

the Save As box is logically separate from the rest of the user interaction. Placing it in `ENUMFONT.C` seemed natural.

Every Windows programmer must be careful with memory allocation. Because I only use a significant amount of memory while generating a report, I decided on a suballocation scheme. The function `get_memory()` gets memory from Windows in 30,000-byte chunks, parceling it out as needed. Since I had to make a lot of small allocations, the suballocation routine was necessary to avoid draining system resources and speed processing. When `free_memory()` is called, all memory previously allocated by `get_memory()` is unlocked and freed.

I found three interesting anomalies while writing FNTPRN. The first is the limit on the number of fonts Write can handle, discussed above. The other two are documentation errors in the 3.1 SDK.

First, I was puzzled by incorrect information coming from `EnumFontFamilies()`. Specifically, the `TEXTMETRIC` element `tmPitchAndFamily` does not work as documented. There is no `TMPF_PITCH` bit, but there is a `TMPF_FIXED_PITCH` bit. Oddly (and contrary to the documentation), when the bit is set, the font has a variable pitch. As I searched Microsoft's Developer Network CD for confirmation (the problem is documented in Q86834), I discovered the next error (Q87975).

The documentation for `EnumFontFamProc` (the callback used by `EnumFontFamilies()`), claims that the first parameter to your callback function is a `LOGFONT FAR*`. In fact, it's an `LP-ENUMLOGFONT`. This pointer and its associated `ENUMLOGFONT` structure is declared in `WINDOWS.H`.

You can find a lot of good discussion about handling fonts under Windows on the Developer Network CD. You'll definitely want to read David Weise and Dennis Adler's "TrueType and Microsoft Windows Version 3.1" and two articles by Ron Gery: "Windows Font Mapping" and "Using TrueType." If you know all about `EnumFonts()` but want to take advantage of 3.1, check out the new capabilities of `EnumFontFamilies()`. □

JOHN DEURBROUCK IS A C AND ASSEMBLY LANGUAGE PROGRAMMER.

ENUMFONT.C

Partial Listing

```
typedef struct tagTRACKFONT{
    LPSTR facename;
    int flags;
    int height;
    int width;
    int narrowness;
    int weight;
    BYTE fonttype;
    LPSTR regular,bold,italic,bolditalic;
}TRACKFONT,FAR* LPTRACKFONT;
```



Figure 4: This structure is used to store information on each font.

Outline Font Selection In OS/2 Programs

BY CHARLES PETZOLD

Outline fonts represent the no-brainer solution to font selection. Outline fonts work on every type of graphics output device (both video displays and printers) and can be manipulated as freely as other graphics objects. Because the OS/2 2.0 GPI (Graphics Programming Interface) comes with 13 standard Adobe Type 1 outline fonts, you can simply use them without even bothering to query an output device to determine what fonts are available (that is, assuming the user hasn't deliberately deleted them from the system). At the very simplest, selecting an outline font for use in a presentation space requires only that you specify the font face name. (Actually, that's not *precisely* true, as we shall see.) After selecting an outline font, you can then scale it to any desired size.

In the last issue, I showed a program that listed all the outline fonts available for the video display. In this column, I'd like to encapsulate the outline font selection and scaling logic in a couple of easy-to-use routines.

THE OLF MODULES Figures 1 and 2 show two files named OLF.H and OLF.C (OLF stands for outline font). These are similar to the BMF (bitmapped font) files I described in the February 9, 1993, issue. To use the three functions in the OLF module, include OLF.H in your program, compile OLF.C, and link with OLF.OBJ. (You can download these files from the Programming Forum on PC MagNet archived as OLF.ZIP.)

The `GetAllOutlineFonts` function enumerates all the outline fonts and stores them in a structure of type `FACE_LIST`, which is defined in OLF.H. This structure consists simply of an integer value indicating the number of typeface names, followed by an array of zero-

terminated 32-character face names. By now the font enumeration logic should look very familiar, so I won't bore you with the details.

The `CreateOutlineFont` function creates a logical outline font. The function takes five parameters. The `hps` parameter is the handle to the presentation space, and `lcid` is the local ID to be associated with the logical font. (A program later selects the font into the presentation space by calling `GpiSetCharSet`.) The next parameter is the font typeface name,

*Like other graphics
objects, outline fonts work
on all types of output
devices and so represent
a simple solution to font
selection, as these sample
routines illustrate.*

You use zero or more constants beginning with the `FATTR_SEL` prefix for the `fsAttributes` parameter. Although you can use `FATTR_SEL_ITALIC` and `FATTR_SEL_BOLD`, these cause GPI to apply simulations to the rasterized characters of the font. That is, for the italic attribute, GPI will tilt the font to the right. For the bold attribute, GPI will overlay two rasterized characters, the second offset a bit to the right of the first. Because outline fonts generally come in true italic, bold, and bold italic versions, applying these simulations is usually unnecessary and undesirable.

Instead, you'll probably want to restrict use of the `fsAttributes` parameter

to the `FATTR_SEL_UNDERSCORE`, `FATTR_SEL_STRIKEOUT`, and the `FATTR_SEL_OUTLINE` constants. That last constant causes GPI to draw the outline of the font without filling the interior. The final parameter to `CreateOutlineFont` is `usCodePage`, which you can set to 0 for the default code page.

The `ScaleOutlineFont` function scales a selected font to a particular point size. Because outline fonts can be scaled to fractional point sizes, the two sizing parameters (`iPointSize` and `iPointWidth`) are given in decipoints, which are $\frac{1}{10}$ of a point. Thus, if you want a 12.5-point font, set `iPointSize` to 125.

For a normally proportioned font, you can set the `iPointWidth` parameter to the same value as `iPointSize`, or to 0. Or you can make a narrower or wider font by using different values of `iPointSize` and `iPointWidth`. For example, if you set `iPointSize` to 120 and `iPointWidth` to 60, the 12-point font will be half the normal width. An `iPointWidth` value of 240 will give you a font that has double the normal width. Do not confuse the `iPointWidth` parameter with the average width of the font characters.

CREATING THE LOGICAL FONT I decided to write `CreateOutlineFont` so that it is not dependent on the font information obtained by `GetAllOutlineFonts`. This means you can use `CreateOutlineFont` without first enumerating the fonts. Simply pass one of the 13 standard OS/2 typeface names to the function. These face names are Courier, Helvetica, and Times New Roman (by themselves or followed by Italic, Bold, or Bold Italic) plus Symbol Set.

The `CreateOutlineFont` function begins by setting up a `FATTRS` structure using the `szFacename`, `fsAttributes`, and `usCodePage` parameters to the function. The `fsType` field is set to the combination

OLF.H

Complete Listing

```

/*-----
OLF.H -- Easy access to OS/2 outline fonts
(c) Charles Petzold, 1993
-----*/

typedef struct
{
    int iNumFaces ;
    char szFacename [1] [FACESIZE] ;
    |
    FACELIST ;
}

typedef FACELIST * PFACELIST ;

PFACELIST GetAllOutlineFonts (HPS hps) ;

LONG CreateOutlineFont (HPS hps, LONG lcid, char * szFacename,
    SHORT fsAttributes, SHORT usCodePage) ;

BOOL ScaleOutlineFont (HPS hps, int iPointSize, int iPointWidth) ;

```



Figure 1: OLF.H defines the structures and files used in OLF.C.

of `FATTR_FONTUSE_OUTLINE` and `FATTR_FONTUSE_TRANSFORMABLE` for creating an outline font. The function then calls `GpiCreateLogFont`, passing a pointer to the `FATTRS` structure.

There's only one little problem: This won't work for a font that consists of non-Latin characters, such as the Symbol Set font. To create a logical font with non-Latin characters, you must set the `usCodePage` field of the `FATTRS` function to 65400. Otherwise, `GpiCreateLogFont` will get the system default font and return the value `FONT_DEFAULT`.

If your program knows it wants to create a symbol font, you can pass 65400 as the `usCodePage` parameter to the `CreateOutlineFont` function. Otherwise, `CreateOutlineFont` does the work for you. It checks that the return value from `GpiCreateLogFont` is `FONT_DEFAULT`, resets the `usCodePage` field to 65400, and calls `GpiCreateLogFont` again.

Of course, creating the logical font is only the first step. The font must later be selected in the presentation space by calling `GpiSetCharSet`. And, for outline fonts, the selected font must be scaled to a particular size.

THE CHARACTER BOX AND TRANSFORMS

A program scales an outline font by calling `GpiSetCharBox`. As we've seen in past columns, this function takes a parameter of type `SIZEF`, a structure that contains two fields for the desired em-

height and em-width of the font. The em-height is the point size of the font measured in vertical coordinates, and the em-width is the point size of the font measured in horizontal coordinates. These two values are generally the same (at least in physical dimensions).

(For typographers and other people who work with text, sizing a font by specifying the point size makes perfect sense. However, there are some programming problems in which text must fit within a fixed width or rectangle. In this case, choose a trial point size and measure the dimensions of the text using `GpiQueryTextBox`. Then scale the point size up or down.)

As I mentioned earlier, the `ScaleOutlineFont` function in `OLF.C` takes a decipoint size directly. However, the character box dimensions passed to the `GpiSetCharBox` function must be given in world coordinates. This requires a calculation to convert the decipoint sizes passed to `ScaleOutlineFont`.

To understand how to perform this conversion, we must first understand something about GPI transforms. (Unfortunately, a complete discussion of GPI transforms would probably occupy several columns.)

Although it's possible for a program to work entirely in device coordinates (that is, pixels), and many programs do so, it is sometimes more convenient to work in another coordinate system. Conversion from one coordinate system to

another is known as a transform. There is nothing very magical about transforms—they are simply mathematical formulas applied to *x* and *y* coordinates to yield new *x* and *y* coordinates.

In almost every GPI function call, points and sizes are specified (and returned) in *world coordinates*. This is a traditional concept in graphics programming. World coordinates are defined simply as "whatever you want them to be." Within GPI, world coordinates are converted to *model coordinates* through the model transform, which you can set using the `GpiSetModelTransformMatrix` function. As the function name implies, this transform is defined by a 3-by-3 matrix and allows the translation of coordinate points, scaling, skewing (tilting left, right, up, or down), and rotation. By default, the model transform matrix is an identity matrix that does nothing.

GPI converts model coordinates to *page coordinates* through the *default viewing* transform that you can set using the `GpiSetDefaultViewMatrix`. Again, this matrix transform allows translation, scaling, skewing, and rotation.

GPI then converts page coordinates to *device coordinates*, which are pixels relative to the lower-left corner of a window. This is known as the *device transform*, and it involves only translation and scaling. The device transform is generally used to draw in units other than pixels, such as fractions of inches or millimeters. You can set the device transform using the `GpiCreatePS` or `GpiSetPS` functions. In this case, the device transform involves only scaling—that is, the page coordinate point (0,0) still maps to the lower-left corner of the window. However, you can alter the device transform using `GpiSetPageViewport` and incorporate translation so the page coordinate point (0,0) maps to someplace other than the lower-left corner.

It's obvious that we want the `ScaleOutlineFont` function in `OLF.C` to work regardless of whether we're drawing in units of pixels, inches, or millimeters. That is, the physical size of a 12-point font on the screen or printer page should be independent of the device transform. This much is clear.

The default viewing and model transforms are often used to zoom into a

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graphics drawing and see it in a larger size. For example, you may want to make the drawing double the size. In such a zoomed-in image, you want a 12-point font to be displayed as twice the normal size. Thus, the physical size of the font should be affected by the default viewing and model transforms, but not the device transform.

Let's see how to solve this problem.

SCALING THE FONT The function `ScaleOutlineFont` in `OLF.C` takes font sizes in decipoints and performs all the necessary conversions to pass values to `GpiSetCharBox`. It begins by using `DevQueryCaps` to obtain the horizontal and vertical font resolution (in dots per inch) of the output device. For the VGA, these values will be 96 dpi; for most laser printers, the resolution is 300 dpi.

The `ScaleOutlineFont` function defines an array of two `POINTL` structures. The `x` and `y` fields of the first are set to 0. The fields of the second are set to the point size in pixels. This is calculated by dividing the decipoint size by 720 to convert to inches, and multiplying by the device resolution in pixels per inch. In the

formulas in `ScaleOutlineFont`, the multiplication occurs first, then 360 is added for rounding, and the result is then divided by 720.

You'll notice that the calculation also includes a multiplicative factor of 16. As you'll recall, the point sizes in the `SIZEF` structure are fixed-point values—a 16-bit integer part and a 16-bit fractional part. In theory, I should be using 65,536 rather than 16, but that might cause an overflow. I'll discuss my rationale for using 16 shortly.

Now we have the character box dimensions of the font in pixels. Next, the `ScaleOutlineFont` function passes the two `POINTL` functions to `GpiConvert`. The `CVTC_DEVICE` and `CVTC_PAGE` parameters indicate that we want device coordinates (pixels) converted to page coordinates. This is how the parameters to the `ScaleOutlineFont` function are made independent of the device transform but not the default page or model transforms.

Let's take an example: Suppose that your program has set page units to *high English*, which means that coordinates

are specified in 0.001 inches. (We'll see how to do this in the next issue.) You've also set a model transform that doubles coordinates and sizes. That is, you want the image to be visually twice as large as normal. You want a 12-point font. On the VGA, this font is 16 pixels tall. That's the font resolution of the VGA (96 dots per inch) times the decipoint size (120) divided by 720. (Let's ignore the multiplication by 16 in the calculations for this example.)

The `GpiConvert` function converts the 16-pixel device units to page units by multiplying by 7,086 (the height of the VGA screen in 0.001 inches) and dividing by 480 (the height of the VGA in pixels) to get a height of 236. This means that the em-height of the 12-point font is 0.236 inches. (I realize that 0.236 seems to be the em-height for a 17-point font, but that's because we're using the video font resolution—higher than the actual resolution—for calculating the font size. I'll discuss an alternative a little later in this column.)

So, we now have a font with an em-height of 236 milli-inches. When it comes

OLF.C

1 of 2

```

/*-----
  OLF.C -- Easy access to OS/2 outline fonts
  (c) Charles Petzold, 1993
  -----*/

#define INCL_GPI
#include <os2.h>
#include <stdlib.h>
#include <string.h>
#include "olf.h"

PFACELIST GetAllOutlineFonts (HPS hps)
{
    static PFACELIST pfl ;
    LONG lFonts = 1, lFonts2 ;
    PFONTMETRICS pfm ;

    // Check for changed fonts

    if ((QFA_PUBLIC & GpiQueryFontAction (hps, QFA_PUBLIC)) && pfl != NULL)
        return pfl ;

    // Delete old structure if necessary

    if (pfl != NULL)
        free (pfl) ;

    // Determine the number of fonts

    lFonts = 0 ;
    lFonts2 = GpiQueryFonts (hps, QF_PUBLIC, NULL, &lFonts, 0, NULL) ;

    if (lFonts == 0)
        return NULL ;

    // Allocate memory for FONTMETRICS structures

    pfm = (PFONTMETRICS) calloc (lFonts, sizeof (FONTMETRICS)) ;

    if (pfm == NULL)
        return NULL ;

    // Get all fonts

    GpiQueryFonts (hps, QF_PUBLIC, NULL, &lFonts,
        sizeof (FONTMETRICS), pfm) ;

    // Allocate memory for FACELIST structure

    pfl = malloc (sizeof (FACELIST)) ;
    pfl->iNumFaces = 0 ;

    // Loop through all fonts

    for (l = 0 ; l < lFonts ; l++)
    {
        // Check if outline font

        if (pfm[l].fsDefn & FM_DEFN_OUTLINE)
        {
            // Reallocate FACELIST structure & store face name

            pfl = realloc (pfl, sizeof (FACELIST) +
                pfl->iNumFaces * FACESIZE) ;

            strcpy (pfl->szFacename[pfl->iNumFaces], pfm[l].szFacename) ;

            pfl->iNumFaces ++ ;
        }

        // Clean up

        free (pfm) ;

    }

    return pfl ;
}

LONG CreateOutlineFont (HPS hps, LONG lcid, char * szFacename,
    SHORT fsAttributes, SHORT usCodePage)
{
    FATTRS fat ;
    LONG lReturn ;

```



Figure 2: OLF.C contains the outline font enumeration, selection, and scaling functions.

OLF.C

2 of 2

```

// Set up FATTRS structure
fat.usRecordLength = sizeof (FATTRS) ;
fat.fsSelection = fsAttributes ;
fat.lMatch = 0 ;
fat.idRegistry = 0 ;
fat.usCodePage = usCodePage ;
fat.lMaxBaselineExt = 0 ;
fat.lAveCharWidth = 0 ;
fat.fsType = FATTR_FONTUSE_OUTLINE |
              FATTR_FONTUSE_TRANSFORMABLE ;
fat.fsFontUse = 0 ;

strcpy (fat.szFacename, szFacename) ;

// Create the font
lReturn = GpiCreateLogFont (hps, NULL, lcid, &fat) ;

// If no match, try a symbol code page
if (lReturn == FONT_DEFAULT && usCodePage == 0)
{
    fat.usCodePage = 65400 ;

    lReturn = GpiCreateLogFont (hps, NULL, lcid, &fat) ;
}

return lReturn ;
}

BOOL ScaleOutlineFont (HPS hps, int iPointSize, int iPointWidth)
{

```

```

HDC     hdc ;
LONG    xRes, yRes ;
POINTL  aptl[2] ;
SIZEF   sizeof ;

// Get font resolution in pixels per inch

hdc = GpiQueryDevice (hps) ;

DevQueryCaps (hdc, CAPS_HORIZONTAL_FONT_RES, 1, &xRes) ;
DevQueryCaps (hdc, CAPS_VERTICAL_FONT_RES, 1, &yRes) ;

// Find desired font size in pixels

if (iPointWidth == 0)
    iPointWidth = iPointSize ;

aptl[0].x = 0 ;
aptl[0].y = 0 ;
aptl[1].x = (16 * xRes * iPointWidth + 360) / 720 ;
aptl[1].y = (16 * yRes * iPointSize + 360) / 720 ;

// Convert to page coordinates

GpiConvert (hps, CVTC_DEVICE, CVTC_PAGE, 2L, aptl) ;

// Set the character box

sizeof.cx = (aptl[1].x - aptl[0].x) << 12 ;
sizeof.cy = (aptl[1].y - aptl[0].y) << 12 ;

return GpiSetCharBox (hps, &sizeof) ;
}

```

time to display the font, the model transform doubles the height of the font from 236 to 472. Then the device transform converts it to pixels by multiplying by 480 and dividing by 7,086. That's 32 pixels. So the 12-point font has been doubled in size by the model transform.

I still haven't finished discussing the ScaleOutlineFont function. After the GpiConvert call, the function subtracts the coordinates of the first POINTL structure (originally initialized to 0) from the second POINTL structure and shifts the results left by 12 bits. Together with the earlier multiplication by 16, this converts an integer value into a fixed-point value in preparation for calling GpiSetCharBox.

The use of two POINTL structures—the first initialized to an origin of (0,0)—allows for cases where the device transform includes translation as well as scaling. This is not common, and it's only possible if a program has used GpiSetPageViewport, but it's something from which the ScaleOutlineFont function protects itself. The two POINTL structures ensure that an actual width and height are being calculated rather than just a point.

WORKING WITH FIXED POINT Many traditional graphics programming systems use floating point extensively for coordi-

nates and sizes. However, GPI sticks to integers for performance purposes. In places where floating point might be more appropriate—such as the character box—then 32-bit fixed-point values are used, providing some of the precision of floating point but without the performance hit.

At first, it doesn't seem necessary to use a fixed-point value for the character box. Let's look at an example, using the EGA. (This is easiest to illustrate with the EGA because the vertical font resolution is 72 dpi; this means that each pixel is 1 point high.) Suppose you want a 12.25-point font. In theory (assuming device coordinates), you should specify the character box as 0x000C4000. But GPI eventually has to rasterize the font—that is, turn the characters into bitmaps that have distinct pixel dimensions. Because there is no such thing as a fractional pixel, the 12.25-point rasterized font will be no different than a 12.00-point font or an 11.75-point font.

The implication here is that fractional point sizes have no meaning on the EGA, and not much more on the VGA. And on 300-dpi laser printers, it doesn't make much sense to specify fonts with a resolution better than about a quarter of a point.

In reality, however, GPI *does* take

fractional character box sizes into account. On the EGA, fonts with point sizes from 11.50 to 12.50 will all have an em-height of 12 pixels, but some of the character widths will be different reflecting the different point sizes. We'll see an example of this in the next issue.

ScaleOutlineFont allows specifying the point size in decipoints. If we want this $\frac{1}{10}$ -point resolution to be reflected in fonts displayed on the EGA and VGA, we must specify character box dimensions with fractional parts that also have at least a $\frac{1}{10}$ resolution. This is the reason why the calculation of the pixel size of the font includes a multiplication by 16. If you're using device coordinates, the character box dimensions will have fractional parts of 0x0000, 0x1000, 0x2000, and so forth. Every distinct decipoint size passed to ScaleOutlineFont will produce a unique character box dimension.

Watch out when using fixed-point values, however: If you raise that value of 16 much higher, you run the risk of overflow, either in the calculation of the pixel dimensions of the font, or deep down in GPI in the GpiConvert function.

FONT RES OR REAL RES? The ScaleOutlineFont shown in OLF.C uses the font resolution of the device (in pixels per inch) to convert the point size to a pixel

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size. The font resolution of video displays is normally higher than the actual resolution. For a VGA, for example, the font resolution is 96 dpi, while the actual resolution is closer to 68 dpi. (For printers, the font resolution is consistent with actual resolution.)

The video font resolution is a value set by the designers of the video device driver. It is chosen to accomplish three goals:

- First, it's easier to design bitmapped fonts when there is a simple relationship between pixels and points. For example, the VGA font resolution of 96 dpi means that there are 4 pixels for every 3 points.
- Second, when using the video display to preview printer output, it is helpful if video fonts are slightly larger than printer fonts because the video display is usually viewed at a further distance than that from which people normally read text on paper.
- Third, video displays are usually wider than paper, so using slightly larger fonts on the screen takes better advantage of video real estate when the video display is used to preview printer output.

However, when displaying outline fonts on the video display, it is possible to scale them based on the actual resolution of the display rather than the font resolution. Here's how to modify *ScaleOutlineFont* to do it:

- First, instead of using the *CAPS_HORIZONTAL_FONT_RES* and *CAPS_VERTICAL_FONT_RES* parameters to *DevQueryCaps*, use *CAPS_HORIZONTAL_RESOLUTION* and *CAPS_VERTICAL_RESOLUTION*. These parameters give you the resolution of the device in the ungainly units of pixels per meter. For the VGA, the values are both 2,667.
- Second, in order to calculate the pixel size of the font, use formulas similar to those shown in the *ScaleOutlineFont* function: Multiply the resolution by the point size, but divide by the magic number 28,346. That's the number of decipoints in a meter.

TESTING IT OUT In the next installment of this column, we'll take a look at a few small programs that put the OLF module through its paces. And then we'll begin to see just how versatile OS/2 outline fonts can be. □

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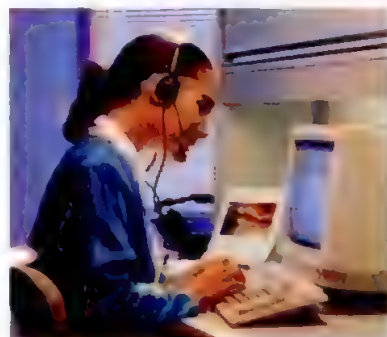


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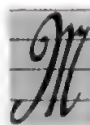
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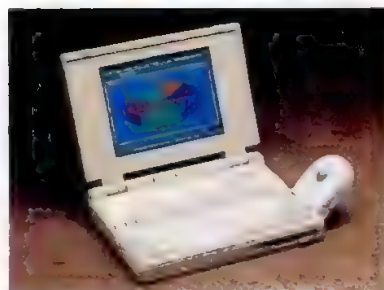


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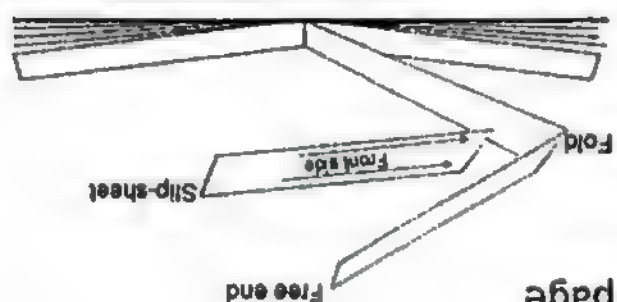
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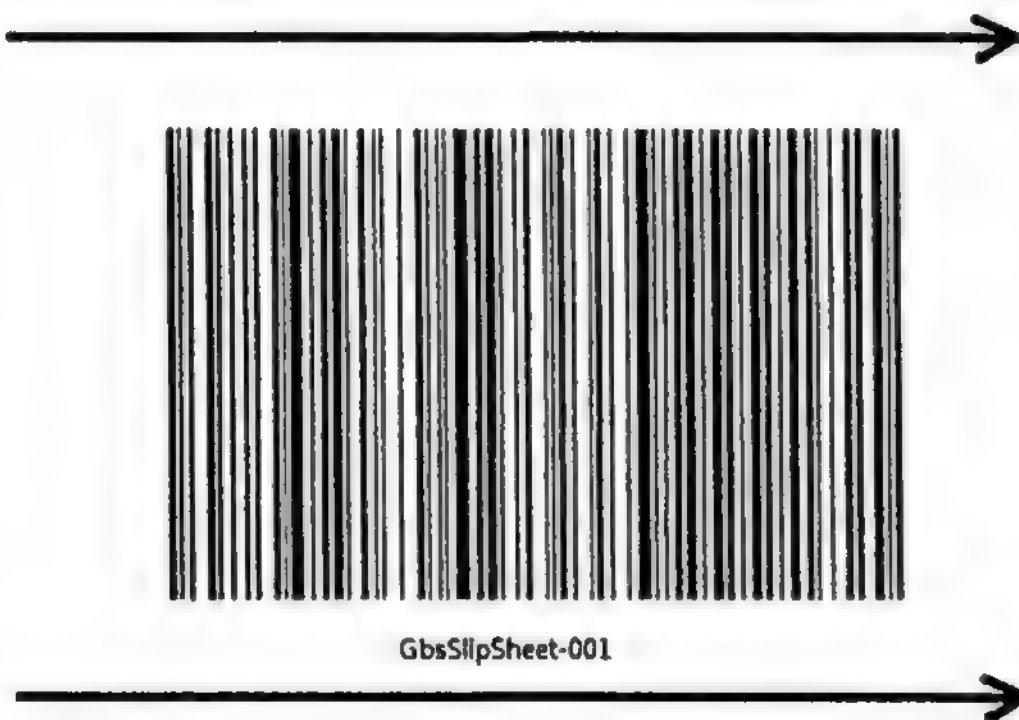
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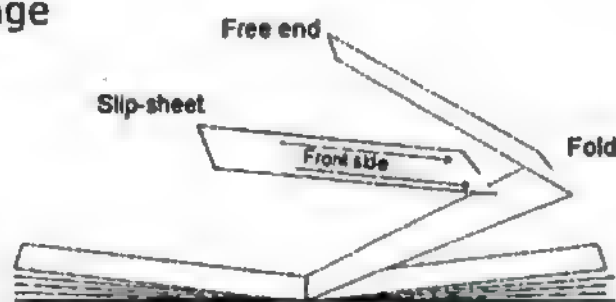
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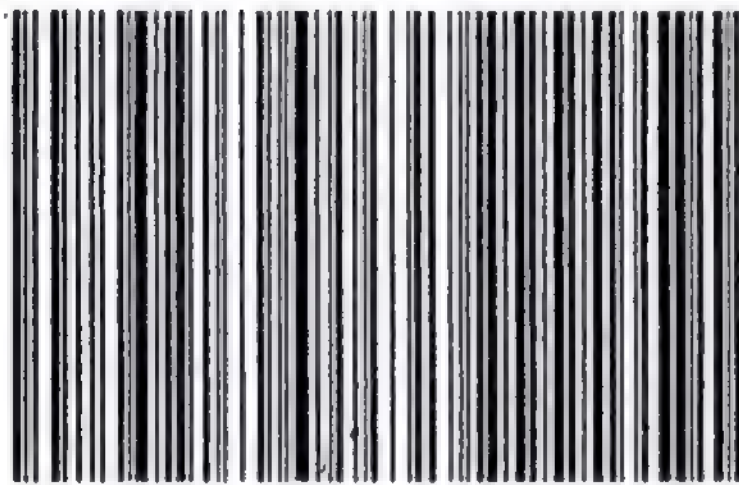
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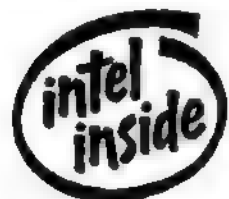
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The Hazards of Exploring Evolving Environments

BY RAY DUNCAN

W

riting about brand new, incompletely documented, rapidly evolving operating systems such as Windows NT is a hobby fraught with perils and sandtraps—some of which, I realize now, I did not successfully avoid. So I'm going to devote this column to cleaning up some of the loose ends.

THE WINAPP SKELETON In the October 13, 1992, issue of *PC Magazine*, I published a code skeleton for a portable table-driven Windows program called WINAPP that could be compiled without changes as either a 16-bit or a 32-bit Windows application. Specifically, WINAPP can be compiled as a 16-bit segmented protected-mode application with Borland C++ 3.x, or as a 32-bit flat model, protected-mode application with Microsoft's CL386 and the Windows NT SDK. WINAPP is just a toy program, but it knows how to carry out many of the fundamental tasks of a Windows application: It processes messages, decodes menu commands, selects a font, paints text in a window, and has a dialog box. Thus, it's a nice demonstration of the fundamental symmetry between the WIN16 and WIN32 APIs and a good starting point for more complex applications that must be compiled for both 16-bit and 32-bit environments.

Unfortunately, I wrote the original WINAPP during a period of rapid evolution of Windows NT and before the release of Borland C++ 3.1, so it failed to take advantage of some of the typedefs and other portability aids that have subsequently become stabilized in both development environments. For example, the #defines and typedefs WNDPROC, CALLBACK, and APIENTRY are now

provided to distinguish between functions that process Windows messages, other functions that are entered directly from Windows, and functions that are exported (for example, by a dynamic link library) to be called by application programs. Figure 1 contains an updated version of the WINAPP program. Figures 2 and 3 contain the header file and resource script that are compatible with Borland C++ 3.1 and the latest Windows NT development tools and header files. (Due to the table-driven nature of WINAPP,

Writing about rapidly evolving operating systems such as Windows NT can be an uncertain enterprise. This column cleans up some of the loose ends that accompany such ventures.

if you are compiling with Borland C++, you should use the Options-Compiler-Frequent Errors menu to turn off warnings for "Parameter indent is never used.")

Suppose you aren't interested in writing applications that can be compiled for both 16-bit and 32-bit environments, but prefer to optimize your programs for the WIN32 API. Then several aspects of WINAPP become quite irrelevant, while other new and perplexing issues such as networking, security, and internationalization loom on the horizon. For example, in the WIN32 environment, window classes must be registered on a per-process basis rather than a per-program

basis. Similarly, calls to MakeProcInstance() and FreeProcInstance() are not necessary in the WIN32 environment (and in fact are essentially converted to NOOPs by #defines in the WIN32 version of WINDOWS.H), so their presence in WINAPP only clutters up the source code.

On the other hand, when writing a WIN32-specific app, you need to position yourself to take advantage of NT's Unicode facilities by being careful to declare strings and characters with the appropriate NT typedefs and macros, TCHAR and TEXT ("..."), instead of the more familiar char and "... keywords. The NTAPP header file and code skeleton are shown in Figures 4 and 5. NTAPP is derived from WINAPP but is WIN32-specific. It merges the old InitInstance() and InitApp() routines into a single procedure, declares strings and characters in a Unicode-compatible manner, and then omits the unnecessary calls to MakeProcInstance() and FreeProcInstance(). The complete set of files necessary to build WINAPP and NTAPP, including the icon file and make files, can be downloaded from the Programming Forum on PC MagNet, archived as WINAPP.ZIP.

MULTIPLE INSTANCES UNDER WINDOWS NT In the December 22, 1992, issue, I mentioned that the WinMain() parameter hPrevInstance is always zero for WIN32 apps, and I used this as an illustration of how much more strictly Windows NT segregates applications one from another. Although multiple instances of a given application do share physical copies of their code and read-only data pages, they run in separate virtual address spaces, register their window classes on a per-instance basis, and in fact have no direct clues as to whether more than one instance is running. After that

WINAPP.C

1 of 2

```

// WINAPP - WIN16 and WIN32 Portable Application Skeleton
// Copyright (C) 1992 Ray Duncan
// PC Magazine * Ziff Davis Publishing

#define dim(x) (sizeof(x) / sizeof(x[0])) // returns no. of elements

#include "windows.h"
#include "winapp.h"

HANDLE hInst; // module instance handle
HWND hFrame; // handle for frame window

TCHAR szShortAppName[] = TEXT("WinApp"); // short application name
TCHAR szAppName[] = TEXT("Windows Demo App"); // long application name
TCHAR szMenuName[] = TEXT("WinAppMenu"); // name of menu resource
TCHAR szIconName[] = TEXT("WinAppIcon"); // name of icon resource

//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
//
struct decodeUINT messages[] = {
    WM_PAINT, DoPaint,
    WM_COMMAND, DoCommand,
    WM_DESTROY, DoDestroy, };

//
// Table of menubar item IDs and their corresponding functions.
//
struct decodeUINT menuitems[] = {
    IDM_EXIT, DoMenuExit,
    IDM_ABOUT, DoMenuAbout, };

//
// WinMain -- entry point for this application from Windows.
//
INT WINAPI WinMain(HANDLE hInstance,
    HANDLE hPrevInstance, LPSTR lpCmdLine, INT nCmdShow)
{
    MSG msg;

    hInst = hInstance; // save this instance handle

    if(!hPrevInstance) // if first instance,
        if(!InitApp(hInstance)) // register window class
            return(FALSE); // exit if couldn't register

    if(!InitInstance(hInstance, nCmdShow)) // create this instance's window
        return(FALSE); // exit if create failed

    while(GetMessage(&msg, NULL, 0, 0)) // while message != WM_QUIT
    {
        TranslateMessage(&msg); // translate virtual key codes
        DispatchMessage(&msg); // dispatch message to window
    }

    TerminateInstance(hInstance); // clean up for this instance
    return(msg.wParam); // return code = WM_QUIT value
}

//
// InitApp --- global initialization code for this application.
//
BOOL InitApp(HANDLE hInstance)
{
    WNDCLASS wc;

    // set parameters for frame window class
    wc.style = CS_HREDRAW|CS_VREDRAW; // class style
    wc.lpfnWndProc = FrameWndProc; // class callback function
    wc.cbClsExtra = 0; // extra per-class data
    wc.cbWndExtra = 0; // extra per-window data
    wc.hInstance = hInstance; // handle of class owner
    wc.hIcon = LoadIcon(hInst, szIconName); // application icon
    wc.hCursor = LoadCursor(NULL, IDC_ARROW); // default cursor
    wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
    wc.lpszMenuName = szMenuName; // name of menu resource
    wc.lpszClassName = szShortAppName; // name of window class

    return(RegisterClass(&wc)); // reg. class, return status
}

//
// InitInstance --- instance initialization code for this application.
//
BOOL InitInstance(HANDLE hInstance, INT nCmdShow)
{
    hFrame = CreateWindow( // create frame window
        szShortAppName, // window class name
        szAppName, // text for title bar
        WS_OVERLAPPEDWINDOW, // window style
        CW_USEDEFAULT, CW_USEDEFAULT, // default position
        CW_USEDEFAULT, CW_USEDEFAULT, // default size
        NULL, // no parent window
        NULL, // use class default menu
        hInstance, // window owner
        NULL); // unused pointer

    if(!hFrame) return(FALSE); // error, can't create window

    ShowWindow(hFrame, nCmdShow); // make frame window visible
    UpdateWindow(hFrame); // force WM_PAINT message
    return(TRUE); // return success flag
}

//
// TerminateInstance -- instance termination code for this application.
//
BOOL TerminateInstance(HANDLE hInstance)
{
    return(TRUE); // return success flag
}

//
// FrameWndProc --- callback function for application frame window.
//
LONG CALLBACK FrameWndProc(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    INT i; // scratch variable

    for(i = 0; i < dim(messages); i++) // decode window message and
    { // run corresponding function
        if(wMsg == messages[i].Code)
            return(messages[i].Fxn)(hwnd, wMsg, wParam, lParam);
    }

    // or hand off to Windows
    return(DefWindowProc(hwnd, wMsg, wParam, lParam));
}

//
// DoCommand -- process WM_COMMAND message for frame window by
// decoding the menubar item with the menuitems[] array, then
// running the corresponding function to process the command.
//
LONG DoCommand(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    INT i; // scratch variable

    for(i = 0; i < dim(menuitems); i++) // decode menu command and
    { // run corresponding function
        if(wParam == menuitems[i].Code)
            return(menuitems[i].Fxn)(hwnd, wMsg, wParam, lParam);
    }

    return(DefWindowProc(hwnd, wMsg, wParam, lParam));
}

//
// DoDestroy -- process WM_DESTROY message for frame window.
//
LONG DoDestroy(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    PostQuitMessage(0); // force WM_QUIT message to
    return(FALSE); // terminate the event loop
}

//
// DoPaint -- process WM_PAINT message for frame window.
//
LONG DoPaint(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    RECT rect;
    HFONT hfont;

    hdc = BeginPaint(hwnd, &ps); // get device context
    GetClientRect(hwnd, &rect); // get client area dimensions
    hfont = CreateFont(36, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0); // get handle for pretty font
    TRUE, 0, 0, ANSI_CHARSET,
    OUT_DEFAULT_PRECIS, CLIP_DEFAULT_PRECIS,
    DEFAULT_QUALITY, (FF_MODERN << 4) + DEFAULT_PITCH,
    TEXT("Ariel"));
    SelectObject(hdc, hfont); // realize font in DC
    DrawText(hdc, TEXT("Hey, Dude!"), -1, // paint text in window
        &rect, DT_CENTER | DT_VCENTER | DT_SINGLELINE);
    EndPaint(hwnd, &ps); // release device context
    return(FALSE); // terminate the event loop
}

```

Figure 1: The source file for the WINAPP application skeleton. This file can be compiled with BC++ 3.1 for the WIN16 API and Windows 3.x, or with Microsoft CL386 for the WIN32 API and Windows NT.

WINAPP.C

2 of 2

```
//
// DoMenuExit -- process File-Exit command from menu bar.
//
LONG DoMenuExit(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    SendMessage(hWnd, WM_CLOSE, 0, 0); // send window close message
    return(FALSE); // to shut down the app
}

//
// DoMenuAbout -- process File-About command from menu bar.
//
LONG DoMenuAbout(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    WNDPROC lpProcAbout; // scratch pointer

    lpProcAbout = MakeProcInstance((WNDPROC) AboutDlgProc, hInst);

    DialogBox(hInst, TEXT("AboutBox"), hWnd, lpProcAbout);
    FreeProcInstance(lpProcAbout);
    return(FALSE);
}

//
// AboutDlgProc -- callback routine for About... dialog
//
BOOL CALLBACK AboutDlgProc (HWND hWnd, UINT msg, UINT wParam, LONG lParam)
{
    if((msg == WM_COMMAND) && (wParam == IDOK))
        EndDialog(hWnd, 0);
    else
        return(FALSE);
}
```

WINAPP.H

Complete Listing

```
//
// WINAPP.H -- Header File for Demo Program WINAPP.C
//

#ifdef WIN32

#define WIN16 TRUE
#define WIN31

#define TCHAR char
#define TEXT(x) x

#define INT int
#define UINT WORD
#define APIENTRY PASCAL
#define WNDPROC FARPROC

#else

#define WIN16 FALSE

#endif

struct decodeUINT { // structure associates
    UINT Code; // messages or menu IDs
    LONG (*Fxn)(HWND, UINT, UINT, LONG); // with a function
};

#define IDM_EXIT 100
#define IDM_ABOUT 101

// Function prototypes
INT APIENTRY WinMain(HANDLE, HANDLE, LPSTR, INT);
BOOL InitApp(HANDLE);
BOOL InitInstance(HANDLE, INT);
BOOL TerminateInstance(HANDLE);
LONG CALLBACK FrameWndProc(HWND, UINT, UINT, LONG);
BOOL CALLBACK AboutDlgProc (HWND, UINT, UINT, LONG);
LONG DoDestroy(HWND, UINT, UINT, LONG);
LONG DoPaint(HWND, UINT, UINT, LONG);
LONG DoCommand(HWND, UINT, UINT, LONG);
LONG DoMenuExit(HWND, UINT, UINT, LONG);
LONG DoMenuAbout(HWND, UINT, UINT, LONG);
```



Figure 2: The header file for the WINAPP application skeleton.

column was published, a number of readers wrote and took me to task for pointing out an obvious problem without at least giving some hints for a solution.

Actually, there are many possible solutions, most of them involving the use of the WIN32 interprocess communications (IPC) mechanisms such as semaphores or shared memory segments. If you need to know how many previous instances of the program are already running, you are pretty much forced to use one of these IPC techniques. However, if you are merely interested in determining whether any previous instances of your program are running, you can obtain this information easily with the aid of the API function FindWindow(). The first parameter passed to FindWindow() is a pointer to the name of your application's window class, and the second parameter is a pointer to a window title (this parameter can be NULL, in which case it is simply ignored). The FindWindow()

function returns the handle of a window with a matching class name (and window title, if that is supplied) or FALSE if no match is found.

So, to set a flag indicating whether an instance of your application is the first instance to be started, you could use code like this:

```
// application window class name
char szClassName[] =
    "MyAppClassName";

// flag set to TRUE if this is
// the first instance of this
// application
BOOL FirstInstance;

FirstInstance = (BOOL)
    !FindWindow(szClassName, NULL);
```

Of course, you must be careful to pick a window class name for your application that is not likely to collide with that of any other program!

THE COMMON OPEN-FILE DIALOG One of C's claims to fame over the years has been that it lets you get close to the hardware, so that knowledge of CPU-specific assembly language is no longer necessary. Another of the major selling points for C has been that programs written in C are portable and can be moved readily from one CPU to another simply by re-compiling. If you suspect a fundamental conflict between these two claims, you are quite correct—it doesn't make sense that a language can be simultaneously hardware-independent and intimately familiar with the hardware. The truth of the matter is that the creation of truly portable C code is a painstaking business and the subject of many articles and book chapters (see, for example, chapter 7 in the *Windows NT Advanced Programming Topics* manual).

WINAPP.RC

Complete Listing

```
// Resource script for WINAPP.C
#include "windows.h"
#include "winapp.h"

WinAppIcon ICON winapp.ico

WinAppMenu MENU
BEGIN
    POPUP            "&File"
    BEGIN
        MENUITEM     "E&xit",        IDM_EXIT
        MENUITEM     SEPARATOR
        MENUITEM     "A&bout",       IDM_ABOUT
    END
END

AboutBox DIALOG 23, 19, 106, 61
CAPTION "About WinApp..."
STYLE DS_MODALFRAME | WS_CAPTION | WS_SYSMENU
BEGIN
    ICON "WinAppIcon", -1, 12, 9, 16, 16, WS_CHILD | WS_VISIBLE
    CTEXT "Microsoft Windows", -1, 33, 7, 64, 8
    CTEXT "Demo Application", -1, 30, 18, 68, 9
    CTEXT "\251 1992 Petit Mal Software", -1, 9, 30, 87, 9
    CONTROL "OK", IDOK, "BUTTON", WS_GROUP, 36, 43, 32, 14
END
```



Figure 3: The resource script for the WINAPP application skeleton.

I was recently reminded of this issue the hard way by some code in the HEXVIEW utility I published in the October 27, 1992, issue. As you may recall, I presented this program as a nontrivial example of a utility that could be compiled for either 16-bit or 32-bit Windows from the same source code base (nontrivial, at least, in the sense that it actually did something useful for the programmer, unlike most of the toy programs that you find in most Windows programming books). Several months after I wrote the program—just about the time it appeared in print—I discovered that some perfectly innocent-appearing code in the program was not portable at all and was seriously broken when compiled for WIN32.

The bug in HEXVIEW really had two interacting causes. First, way back when Windows 3.1 was still in beta testing, I had cloned some code for the `GetOpenFileName()` common dialog API from examples in on-line documentation, and never revisited the example in the final SDK or thought carefully about whether the code was optimal. Second, I failed to read the fine print in the CL386 documentation about alignment of static data items. The code that caused the problems in the HEXVIEW utility was as follows:

```
char *szFilter[] = {
    "All Files (*.*)",
    "**.*",
    "Executable Files (*.EXE)",
    "**.EXE",
    "Object Modules (*.OBJ)",
    "**.OBJ",
    "" };
ofn.lpstrFilter = szFilter[0];
```

What does this code do? It declares an array of pointers to a series of ASCII strings, the entire set of strings being terminated by an extra zero byte, then it copies the first pointer from the array of pointers to the variable `ofn.lpstrFilter`. Conceptually, the strings are viewed as sets of pairs. The first member of each pair is used by the common file-open dialog to initialize a combobox control in the lower left corner of the dialog. When the user chooses one of the items that appears in the combobox, the second member of the corresponding pair is used to initialize the file name edit control in the upper left corner of the dialog and to filter or select the filenames that are shown in the listbox that appears just below the edit control.

The code above happens to work when compiled for WIN16, but this is more a result of good fortune than good planning. The code is nonportable because it is implicitly relying on the compiler to not insert *extra bytes* between the strings, and because the strings might not fall in the expected order (or even end up as contiguous) if certain optimizations are performed.

The code is also suboptimal and unnecessarily obscure: The array of pointers wastes memory because only the first pointer is ever used, and the pointer array introduces a layer of indirection that isn't needed at all.

The code fails when compiled for WIN32 because the CL386 compiler aligns the beginnings of static strings on DWORD boundaries. Thus, depending on the length of the individual strings, more than one null or uninitialized byte may intervene between strings, and the code in the common dialog library that scans across the set of filter strings can (and does) terminate prematurely. Correct code, which inserts the null bytes into the filter string array explicitly, allows for the possibility of Unicode, and takes advantage of the compiler's ability to concatenate strings, is as follows:

```
TCHAR szFilter[] = {
    TEXT("All Files (*.*)\0")
    TEXT("**.*\0")
    TEXT("Executable Files (*.EXE)\0")
    TEXT("**.EXE\0")
    TEXT("Object Modules (*.OBJ)\0")
    TEXT("**.OBJ\0")
    TEXT("\0") };
ofn.lpstrFilter = szFilter;
```

This code has the additional advantage that it is considerably easier to understand! My thanks to Brent Rector and Bob Landau who took the time to discuss this with me on CompuServe.

THE WINDOWS ENVIRONMENT When you write a Windows application, the choice of 16- or 32-bit "bitness" and memory models does not necessarily dictate the operating environment. WIN16 apps will run perfectly well on Windows NT with the aid of its "Windows on Windows"

NTAPP.H

Complete Listing

```
//
// NTAPP.H -- Header File for Demo Program NTAPP.C
//

struct decodeUINT {
    UINT Code;
    LONG (*Fxn)(HWND, UINT, UINT, LONG); }; // structure associates
                                           // messages or menu IDs
                                           // with a function

#define IDM_EXIT 100
#define IDM_ABOUT 101

// Function prototypes
INT APIENTRY WinMain(HANDLE, HANDLE, LPSTR, INT);
BOOL InitInstance(HANDLE, INT);
BOOL TerminateInstance(HANDLE);
LONG CALLBACK FrameWndProc(HWND, UINT, UINT, LONG);
BOOL CALLBACK AboutDlgProc(HWND, UINT, UINT, LONG);
LONG DoDestroy(HWND, UINT, UINT, LONG);
LONG DoPaint(HWND, UINT, UINT, LONG);
LONG DoCommand(HWND, UINT, UINT, LONG);
LONG DoMenuExit(HWND, UINT, UINT, LONG);
LONG DoMenuAbout(HWND, UINT, UINT, LONG);
```



Figure 4: The header file for the NTAPP application skeleton.

(WOW) emulation layer, while WIN32 applications that do not depend on capabilities that are unique to Windows NT will run equally fine on Windows 3.1 if the WIN32S DLLs and VxD are installed. So how does a program go about determining what kind of a system it is running on? Regrettably, there is not a portable solution that works in a symmetric manner for both 16-bit and 32-bit apps.

WIN16 programs must first call GetWinFlags() and test the state of the WF_WINNT flag to determine whether they are running under plain Windows or

Windows NT. If the WF_WINNT flag is FALSE, the program should then call GetVersion(), which returns a LONG result: The Windows version number is in the low 16-bits, and the DOS version is in the high 16-bits. If the WF_WINNT flag is TRUE, the application is running under Windows NT, and it can identify the host processor by testing the GetWinFlags() result for the WF_CPU4000 and WF_CPUALPHA21064 flags. Of course, GetVersion() can also be called under Windows NT, but the result in this case is not as useful; the WOW GetVersion() returns the version of the 16-bit

Windows API and the MS-DOS API that is being emulated, not the version of Windows NT itself.

WIN32 applications, on the other hand, must first call GetVersion() to identify the host system. In the WIN32 API, the most significant bit of the GetVersion() result is FALSE for Windows NT and TRUE for WIN32S on DOS. The remainder of the high 16-bits of the GetVersion() result is reserved, and the low 16-bits of the result contains the Windows subsystem version number. A WIN32 program that needs to identify the processor type must call GetSystemInfo(); the GetWinFlags() function is not supported in WIN32.

PRIVATE .INI FILES In my October 27, 1992, column, I wrote: "One very important divergence between the WIN16 and WIN32 environments, which does not show up in our HEXVIEW code at all, is the handling of the information that is stored and retrieved by the Windows functions WritePrivateProfileString(), GetPrivateProfileString(), and GetPrivateProfileInt(). In Windows 3.x, this information is stored in a plain ASCII text file named (in this particular case) HEXVIEW.INI in the C:\WINDOWS directory. Under NT, the information is stored in an indexed binary database on a per-user basis, protected by access control lists."

I made this statement based on something I read a long time ago in the preliminary WIN32 specification. However, I

NTAPP.C

1 of 2

```
// NTAPP.C - Application Skeleton for Windows NT and WIN32
// Copyright (C) 1992 Ray Duncan
// PC Magazine * Ziff Davis Publishing

#define DIM(x) (sizeof(x) / sizeof(x[0])) // returns no. of elements

// delete next line to use ANSI character set instead of UNICODE
#define UNICODE

#include "windows.h"
#include "NTApp.h"

HANDLE hInst; // module instance handle
HWND hFrame; // handle for frame window

TCHAR szShortAppName[] = TEXT("NTApp"); // short application name
TCHAR szAppName[] = TEXT("Windows NT Demo"); // long application name
TCHAR szMenuName[] = TEXT("NTAppMenu"); // name of menu resource
TCHAR szIconName[] = TEXT("NTAppIcon"); // name of icon resource

//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
//
```

```
struct decodeUINT messages[] = {
    WM_PAINT, DoPaint,
    WM_COMMAND, DoCommand,
    WM_DESTROY, DoDestroy, };

//
// Table of menu item IDs and their corresponding functions.
//
struct decodeUINT menuitems[] = {
    IDM_EXIT, DoMenuExit,
    IDM_ABOUT, DoMenuAbout, };

//
// WinMain -- entry point for this application from Windows.
//
INT APIENTRY WinMain(HANDLE hInstance,
    HANDLE hPrevInstance, LPSTR lpCmdLine, INT nCmdShow)
{
    MSG msg;

    hInst = hInstance; // save this instance handle

    if(!InitInstance(hInstance, nCmdShow)) // create this instance's window
        return(FALSE); // exit if create failed
```



Figure 5: The source file for the WIN32 and Windows NT application skeleton. This file is Unicode compatible and assumes the availability of the WIN32 API; it cannot be compiled for WIN16.

NTAPP.C

2 of 2

```

while(GetMessage(&msg, NULL, 0, 0)) // while message != WM_QUIT
{
    TranslateMessage(&msg); // translate virtual key codes
    DispatchMessage(&msg); // dispatch message to window
}

TermInstance(hInstance); // clean up for this instance
return(msg.wParam); // return code = WM_QUIT value
}

//
// InitInstance --- instance initialization code for this application.
//
BOOL InitInstance(HANDLE hInstance, INT nCmdShow)
{
    WNDCLASS wc;

    // set parameters for frame window class
    wc.style = CS_HREDRAW|CS_VREDRAW; // class style
    wc.lpfnWndProc = FrameWndProc; // class callback function
    wc.cbClsExtra = 0; // extra per-class data
    wc.cbWndExtra = 0; // extra per-window data
    wc.hInstance = hInstance; // handle of class owner
    wc.hIcon = LoadIcon(hInst, szIconName); // application icon
    wc.hCursor = LoadCursor(NULL, IDC_ARROW); // default cursor
    wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
    wc.lpszMenuName = szMenuName; // name of menu resource
    wc.lpszClassName = szShortAppName; // name of window class

    if(!RegisterClass(&wc)) // register window class,
        return(FALSE); // exit if reg. fails

    hFrame = CreateWindow( // create frame window
        szShortAppName, // window class name
        szAppName, // text for title bar
        WS_OVERLAPPEDWINDOW, // window style
        CW_USEDEFAULT, CW_USEDEFAULT, // default position
        CW_USEDEFAULT, CW_USEDEFAULT, // default size
        NULL, // no parent window
        NULL, // use class default menu
        hInstance, // window owner
        NULL); // unused pointer

    if(!hFrame) return(FALSE); // error, can't create window

    ShowWindow(hFrame, nCmdShow); // make frame window visible
    UpdateWindow(hFrame); // force WM_PAINT message
    return(TRUE); // return success flag
}

//
// TerminateInstance -- instance termination code for this application.
//
BOOL TerminateInstance(HANDLE hInstance)
{
    return(TRUE); // return success flag
}

//
// FrameWndProc --- callback function for application frame window.
//
LONG CALLBACK FrameWndProc(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    INT i; // scratch variable

    for(i = 0; i < dim(messages); i++) // decode window message and
    { // run corresponding function
        if(wMsg == messages[i].Code)
            return((*messages[i].Fxn)(hwnd, wMsg, wParam, lParam));
    }

    // or hand off to Windows
    return(DefWindowProc(hwnd, wMsg, wParam, lParam));
}

//
// DoCommand -- process WM_COMMAND message for frame window by
// decoding the menubar item with the menuitems[] array, then
// running the corresponding function to process the command.
//
LONG DoCommand(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    INT i; // scratch variable

    for(i = 0; i < dim(menuitems); i++) // decode menu command and
    { // run corresponding function
        if(wParam == menuitems[i].Code)
            return((*menuitems[i].Fxn)(hwnd, wMsg, wParam, lParam));
    }

    return(DefWindowProc(hwnd, wMsg, wParam, lParam));
}

//
// DoDestroy -- process WM_DESTROY message for frame window.
//
LONG DoDestroy(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    PostQuitMessage(0); // force WM_QUIT message to
    return(FALSE); // terminate the event loop
}

//
// DoPaint -- process WM_PAINT message for frame window.
//
LONG DoPaint(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    RECT rect;
    HFONT hfont;

    hdc = BeginPaint(hwnd, &ps); // get device context
    GetClientRect(hwnd, &rect); // get client area dimensions
    hfont = CreateFont(36, 0, 0, 0, 700, // get handle for pretty font
        TRUE, 0, 0, ANSI_CHARSET,
        OUT_DEFAULT_PRECIS, CLIP_DEFAULT_PRECIS,
        DEFAULT_QUALITY, (FF_MODERN << 4) + DEFAULT_PITCH,
        TEXT("Ariel"));
    SelectObject(hdc, hfont); // realize font in DC
    DrawText(hdc, TEXT("Hey, Dude!"), -1, // paint text in window
        &rect, DT_CENTER | DT_VCENTER | DT_SINGLELINE);
    EndPaint(hwnd, &ps); // release device context
    return(FALSE); // terminate the event loop
}

//
// DoMenuExit -- process File-Exit command from menu bar.
//
LONG DoMenuExit(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    SendMessage(hwnd, WM_CLOSE, 0, 0); // send window close message
    return(FALSE); // to shut down the app
}

//
// DoMenuAbout -- process File-About command from menu bar.
//
LONG DoMenuAbout(HWND hwnd, UINT wMsg, UINT wParam, LONG lParam)
{
    DialogBox(hInst, TEXT("AboutBox"), hwnd, AboutDlgProc);
    return(FALSE);
}

//
// AboutDlgProc -- callback routine for About... dialog
//
BOOL CALLBACK AboutDlgProc(HWND hwnd, UINT msg, UINT wParam, LONG lParam)
{
    if((msg == WM_COMMAND) && (wParam == IDOK))
        EndDialog(hwnd, 0);
    else
        return(FALSE);
}

```

realize now that I should have paid more attention to what was actually happening in the system. The WritePrivateProfileString(), GetPrivateProfileString(), and GetPrivateProfileInt() functions work exactly the same way under Windows 3.x and Windows NT in both the WIN16 and

WIN32 environments—except that the .INI file is stored in the C:\WINDOWS directory under Windows 3.x and is stored in the C:\WINNT directory under Windows NT.

What if you prefer to continue to use the WritePrivateProfileString() and

ReadPrivateProfileXXX() functions in your source code, but you want the information to be stored in the system registry rather than in text files? Windows NT provides for this contingency with an .INI-file mapping facility, which is controlled by the key:


```
HKEY_LOCAL_MACHINE\Software
\Description\Microsoft\Windows\NT
\CurrentVersion\IniFileMapping
```

in the system registry. More information about .INI-file mapping can be found in the Registration and Initialization Files Overview section of the Windows NT SDK on-line documentation.

FILE HANDLES AND TOKENS One more important point that I failed to make clear in the discussion of my HEXVIEW program (October 27, 1992) and my HEXVIEW2 program (November 10, 1992) is that there are two distinct ways to open a file using the WIN32 API, and they are not interchangeable. Each method returns a unique type of file token and must be used only with the read, write, seek, and close functions that are appropriate to that token. Specifically:

- `_lopen()` and `OpenFile()` return an `HFILE` and are used with `_lread()`, `_lwrite()`, `_llseek()`, and `_lclose()`;
- `CreateFile()` returns a `HANDLE` and is used with `ReadFile()`, `ReadFileEx()`, `WriteFile()`, `WriteFileEx()`, `SetFile-`

`Pointer()`, and `CloseHandle()`.

If you mix and match file operations you may get inexplicable results.

ACCESS TO PC MAGAZINE SOURCE CODE

Since I started including my Internet address in this column, I have gotten a barrage of e-mail asking me where the source code for *PC Magazine* utilities, Lab Notes, Environments, and Power Programming examples can be obtained on the net. The answer is that there is no official Ziff-Davis FTP site for these programs, but there are many unofficial FTP sites that have the source code available. The best known of these is probably `wsmr-simtel20.army.mil`, where the programs from each issue of *PC Magazine* can be found in directory `PD1:[MSDOS.PCMAG]` in archive files with names of the form `VOLxxNxx.ZIP.1`.

For example, to obtain the files for this issue, you would access the simtel20 FTP server with the command:

```
ftp wsmr-simtel20.army.mil
```

Log in as "anonymous," giving your

Internet mail address as the password, then enter the commands:

```
cd pd1:[msdos.pcmag]
binary
get VOL12N07.ZIP.1
quit
```

A popular mirror site for simtel20 is `garbo.uwasa.fi`. For additional alternative sites, see the README files in the root FTP directory of simtel20, or use the archive file finder.

If you want to find out what the Internet has to offer, I highly recommend *The Whole Internet User's Guide and Catalog*, written by Ed Krol of *The Hitchhiker's Guide to the Internet* fame. This book is published by O'Reilly and Associates Inc., Sebastopol, Calif. ISBN: 1-56592-025-2.

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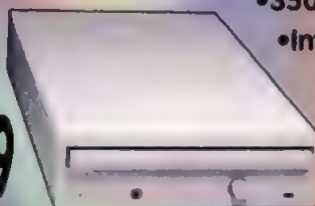
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INDEX

Systems

Ariel Design, Inc.	348
Comtrade	367
Edge/Micron	363
Expo Tech	357
Global Horizons	391
Insight Distribution	
Network	334
Mitac	354
PCs Compleat	350,361
Tangent Computer, Inc.	344
Tri-Star Computers	346
USA Flex	368

Software/Peripherals/ Components

American Small Business	
Computers	395
Arlington Computer	
Products	390
Buffalo Products	398
Compuclassics	379
Computability	374
COMPUTER DISCOUNT	
WAREHOUSE	380
Computer Express	378
DUSTIN DISCOUNT	
SOFTWARE	332,340

FASTMICRO	384
First Source International	376
Global Horizons	391
H. Co Memory Upgrades	399
Insight Distribution	
Network	338
LA Trade	394
Midwest Computer Works	396
Pacific Wave	387
PCs Compleat	350,361
PC Zones	392
TELEMART	397
Worldwide Technology	386

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based on
sequential read
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on a 486 local
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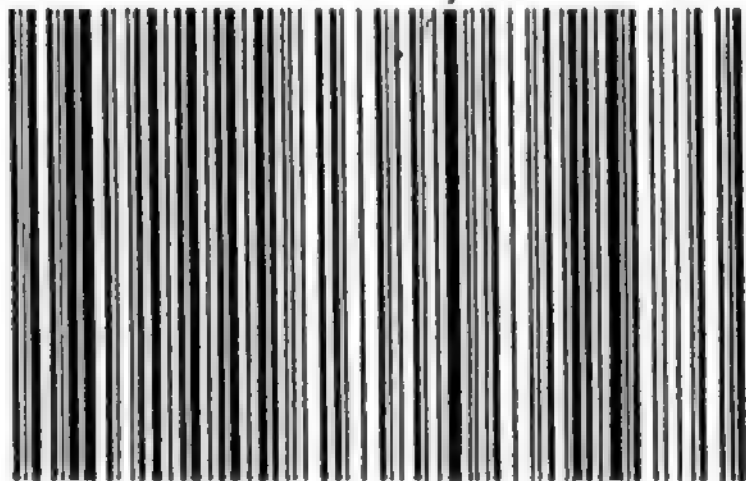
-PC Sources

PC Sources, January 1993 "Buying into Local Bus"

1. Follow instructions on the other side

Back

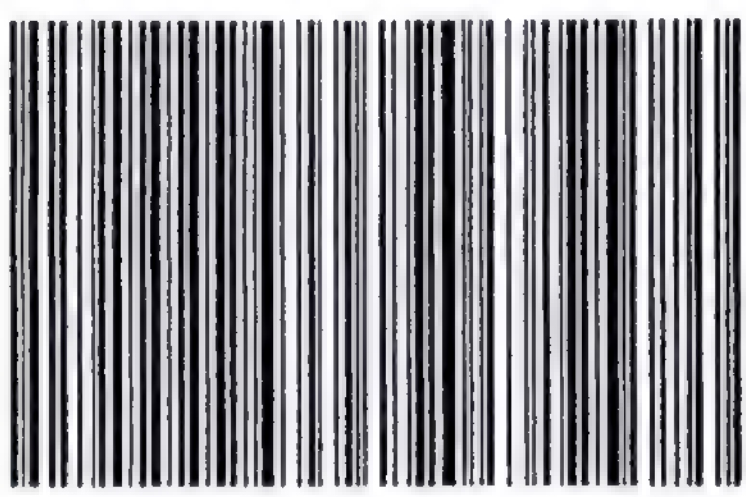
Gbs5lipBack-0018



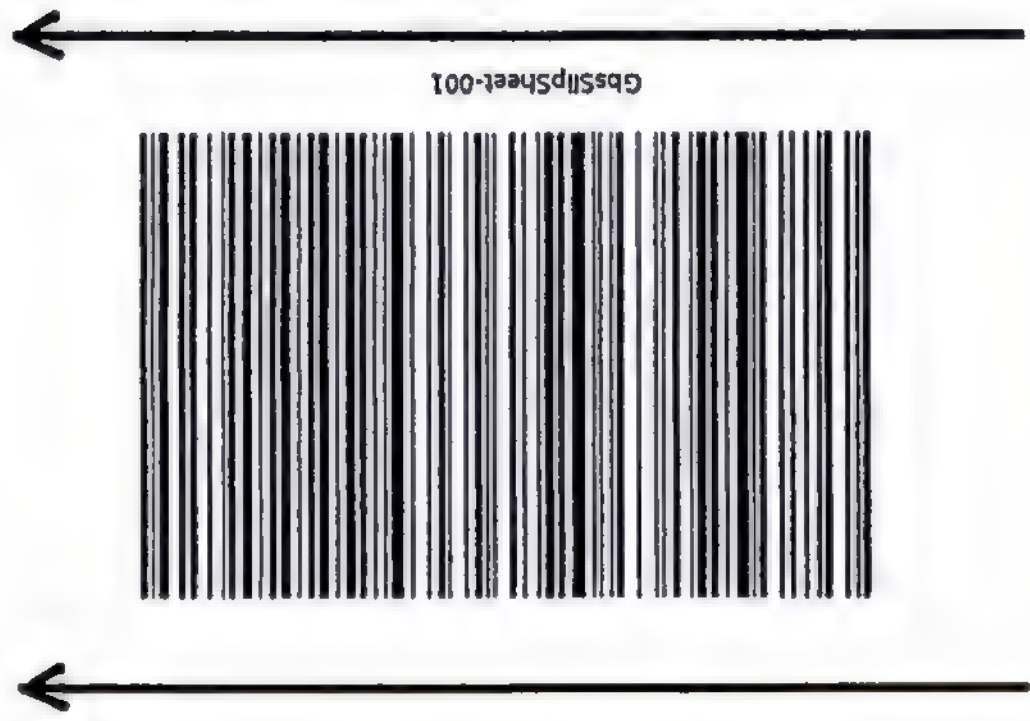
Inverted Back

1. Follow instructions on the other side

Folded edge of the page

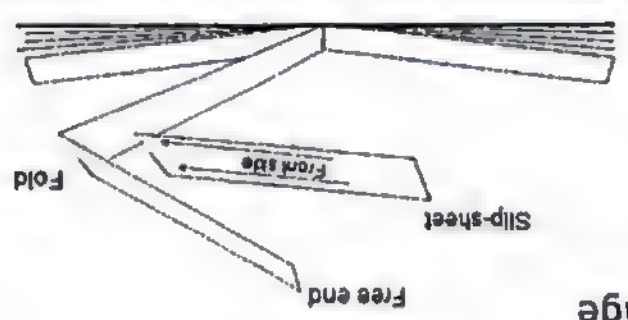
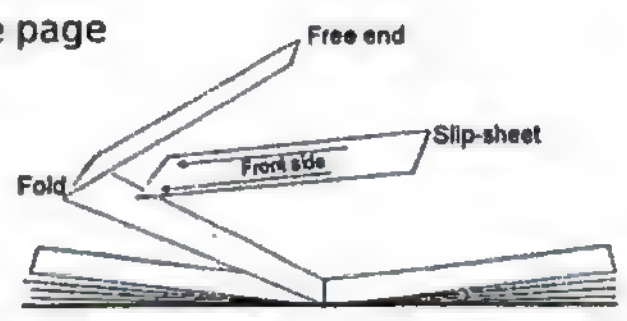


GbsSlipSheet-001



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
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3. Slice the folded edge
4. Close the page and slip-sheet



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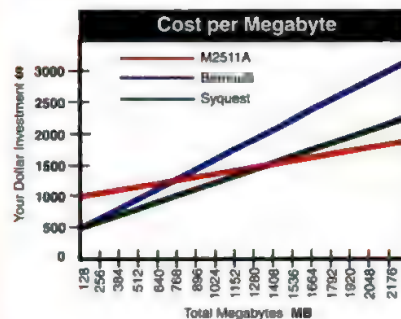
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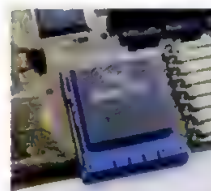
Based on Winmarks 2.5
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-PC Sources

PC Sources, January 1993 "Buying into Local Bus"

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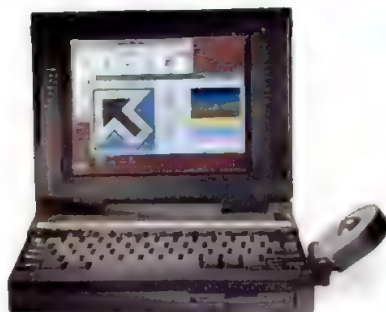
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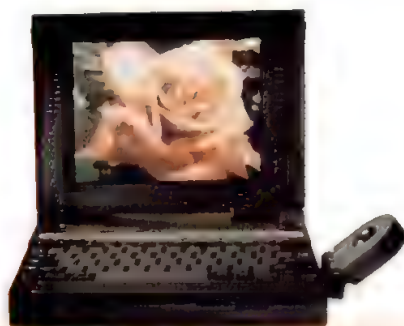
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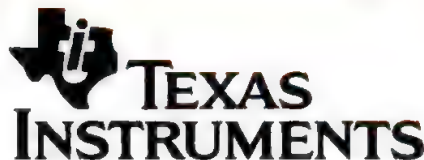


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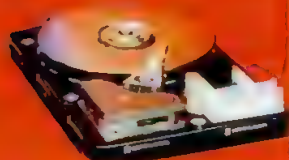


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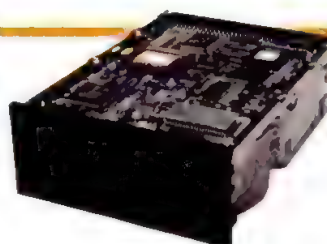
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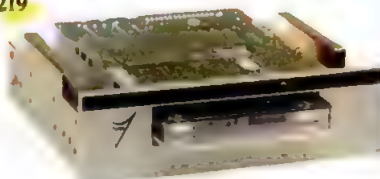
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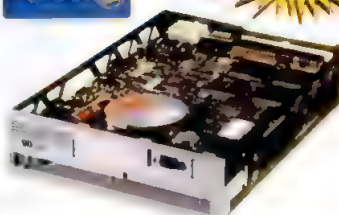
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PCs

HARD DISK PARTITIONS

► **PC MAGAZINE:** If you want to observe a heated discussion, just get a few power users together and ask them one question: Should you divide large-capacity hard disks into multiple partitions?

When the IBM-XT arrived on the scene, it came with a 10MB hard disk that held as much data as 30 floppy disks. At the time, people felt that it would take years to use up all this space. We found out the truth all too soon, and now we take for granted that typical hard disks have capacities from 100MB to 300MB or more.

Back in the days of DOS 3.x, you were limited to 32MB hard-disk partitions (unless you used a special utility to create larger ones), which meant that a 90MB drive had to be carved up into at least three logical sections. As far as DOS was concerned, you had three different physical drives; if you ran out of space on Drive C:, you couldn't automatically use the available space on D: or E:, even though they were part of the same physical drive.

Starting with DOS 4.0, however, you could create partitions larger than 32MB, and with DOS 5.0 you can define an entire drive (up to 2GB) as a single partition. Certainly, it's more convenient to have the whole disk available as a single partition, but at what cost?

The problem lies in the way DOS keeps track of space on your disk. The FDISK utility creates up to 64K worth of entries in the file allocation table (FAT); floppy disks have fewer entries. Each entry represents one cluster, or group of sectors. The size of the cluster varies according to disk size. DOS divides the total number of sectors on the disk by 64K, then rounds up to the nearest power of 2 to find the number of sectors per cluster. It then creates two copies of the FAT, with that many entries in each. Bigger partitions have more sectors, so the clusters must increase as well.

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This is significant because a cluster is the smallest amount of disk space that a DOS file can occupy. On disks up to 128MB, each cluster consists of four 512-byte sectors, or 2K per cluster.

It's easy to figure out how big the clusters will be for a given hard-disk partition. Take the number of megabytes and divide by 64, then round that up to the nearest power of 2. For example, to find

how big the clusters are on a 300MB hard disk, divide 300 by 64—you get 4.69; now round up to the nearest power of 2, which is 8. The disk will have 8K clusters.

The main problem is that this arrangement all but guarantees that you can't fill your hard disk with data. Since clusters can't be shared by files, a 1-byte file on a hard disk with 2K clusters will occupy the same amount of space as a 2,048-byte file. Files larger than 2K will occupy more than one cluster. It's extremely unlikely that your files will completely fill their last clusters. Assuming a random distribution of file sizes (a questionable assumption, as we'll discuss in a moment), you end up wasting about half a cluster for every file. So if you have a 100MB hard disk with 2K clusters, and you have 1,000 files, you are "losing" about 1MB of disk space.

Larger partitions have larger clusters, however. Partitions of 128MB and 256MB will have 4K clusters. With 1,000 files on a 200MB hard disk, you can estimate that you're losing about 2MB of space. And on a 300MB drive with 8K clusters, you are losing 4MB. A 2GB drive will have 32K clusters, and will lose 16MB of space.

All this assumes that you have only 1,000 files on each hard disk. It also assumes you have file sizes that randomly fill the last cluster in the chain for each file, no matter what size the cluster happens to be. Both of these assumptions

INDEX

PCs

Hard-disk partitions 342

Operating Environments

Keeping Clock handy 343

Graphics accelerators for OS/2 345

Word

Processing

Editing equations in WordPerfect 5.1 345

Spreadsheets

Excel 3-D shading macro 347

Databases

Understanding FoxPro's File function 349

The Del key in Paradox 353

Graphics

Cross-column alignment 356

Networking

Sharing a phone line 360

Languages

Using high-intensity colors 362

may not even come close to reality.

If you change your premise so that you assume 1,000 files per 100MB of hard disk space, the picture changes dramatically. On the 100MB drive, you still lose the same 1MB as before, or about 1 percent of the total capacity. On the 200MB drive, however, you have 2,000 files losing an average of 2K apiece, or 4MB in all—2 percent of the total space. For the 300MB drive, you have 3,000 files; that's 12MB lost, or 4 percent of the total. And on our 2GB drive, with 20,000 files, you lose 320MB—a whopping 16 percent. If you have more than 10 files per megabyte, the percentage of lost space will be even larger.

But wait—it gets worse. The second flaw in our initial notion was to presume an even distribution of file sizes, so that the files randomly fill the last cluster in the chain. This may be a workable assumption when clusters are small, such as 2K, but it doesn't hold up when cluster sizes get large. My 300MB hard disk currently holds about 10,000 files which take up about 300,000,000 bytes. (Isn't everyone's disk always full?) That averages out to 30,000 bytes per file, or about 29K. The problem is that a large number of these bytes are taken up by a relatively small number of files; my Windows directory has about 250 files, but nearly one-third are larger than 29K. This means that the remaining two-thirds are smaller, and many of them must be much smaller. In fact, almost a third are smaller than 1K.

From this we can conclude that assuming an even distribution of file sizes is probably wrong, especially as cluster sizes increase. If my Windows directory is representative, then I'm wasting all but 1K of the cluster size for a third of the files on my disk. With 10,000 files in all, and a cluster size of 8K, that's 7K for each of 3,300 files, or 23MB in all. That's 8 percent of my hard disk capacity.

You can beat the system by dividing larger disks into two or more partitions; if you make them less than 128MB apiece, you get down to the 2K cluster. Is it worth it?

In the case of my 300MB drive, I could make some significant gains just by splitting it into two partitions: one 256MB and the other 44MB. The larger partition would have 4K clusters instead of the cur-

rent 8K, and this would reduce my losses from the 3,300 "small" files to about 10MB ($3,300 \times (4-1)/1,000=9.9$)—that's like getting a free 13MB. Add in the savings of at least a half-cluster, on average, for the other 6,700 files and I'd recover more than another 13MB ($2 \times 6,700/1,000=13.4$). By sticking my smallest files in the 44MB partition with its 1K clusters, I'd probably get back as much as 30MB in all—which is like adding 10 percent more storage space absolutely free.

So why don't I divide my hard disk? It's mostly a matter of the potential inconvenience. If you divide a drive into two or more partitions, you're more likely to fill one partition while there's still space available in the other. I bought a big disk so I wouldn't have to worry about running out of space, and I'm willing to waste 10 percent of it to avoid shuffling files from one partition to another.

It's a completely different story for larger-capacity drives. When I get my next hard disk (which will probably be in the 800 to 900MB range), I will certainly partition it. To make most efficient use of the cluster size, I'll make them fit the power-of-two boundaries: a 512MB partition, a 256MB partition, and the re-

mainder in a third partition.

This doesn't resolve the endless arguments, of course; users are still going to disagree about the correct number and size of partitions. It's largely a matter of personal preference. The important point is that you should be aware of just how much space can be lost to large clusters, and that the proportion lost can be even greater on large disks (over 512MB) than on smaller ones.—*Alfred Poor*

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Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Or maybe you'd like a better understanding of how something works. If so, we invite you to let us know about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

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For any tip we print, you'll receive \$50 plus a *PC Magazine* T-shirt. We regret that we cannot answer letters individually.

Operating Environments

KEEPING CLOCK HANDY

TIP The Windows 3.1 Clock accessory has a neat "Always On Top" feature that enables it to stay on top of other windows and not get covered. This option isn't obvious at first because it appears on the Control menu, not the Settings menu. After selecting this feature, use the Settings menu to choose the Digital option, display only time and seconds, and select No title. Now size the Clock as small as possible. Maximize any other application and place the Clock (which should still

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be visible) at the very top of the screen, with the right edge just to the left of the minimize button of your other application. The Clock will always be visible, taking up a minimum of space in a location that's seldom used.

*Robert Wells
Spartanburg, South Carolina*

► **PC MAGAZINE:** In Windows 3.1, any program has the potential to "float" above all other windows, even when it's not active. Our own *PC Magazine* utility TOTOP (September 29, 1992) can activate or deactivate this feature in other programs. Of course, an application that floats above the active application had better occupy as little of the screen as possible. Downsizing the Clock utility to fit on the title bar of another program cleverly keeps it from getting in the way.

It's always possible to resize the Clock applet so its height is barely larger than a program's title bar, but at that size the time is only visible when the No title style is selected. If you want Clock to always start in this minimized state, you have to be careful how you close the program. To close down Clock using the normal control menu box, you must first bring back the title bar by double-clicking on the time display or pressing Esc while Clock is active. But that means the next time you start the program it will appear with the title bar showing, not the time, and you'll have to select No title from the Settings menu again.

The solution? Either leave Clock running all the time, so that it terminates when Windows terminates, or shut it down via the Task Manager. Double-click on the desktop or press Ctrl-Esc to bring up the Task Manager, select Clock in the list box, and press the End Task button. This closes Clock while retaining the No title style.—*Neil J. Rubenking*

GRAPHICS ACCELERATORS FOR OS/2

❖ I've been hearing a lot lately about video cards that speed up Windows. Can you tell me if there are any cards that do the same for OS/2 2.0?

*Josh Macon
Syracuse, New York*

► **PC MAGAZINE:** The answer is yes. In fact, the cards that speed up Windows's video can do the same for OS/2. The catch (and up to now it's been a significant one) is that the video card vendors have to do what they've done for Windows: write custom video drivers. Unfortunately, it took IBM quite a while to make the device-driver development kits (DDKs) available, so it's only been since late summer that video card vendors have started to release OS/2 2.0 versions of their drivers.

There are a number of custom drivers available now. Many are still in wide-beta testing at the time of this writing, though users report that they work as promised. You can get copies of the drivers by downloading them from the OS2USER forum on CompuServe, or you can contact the IBM National Support Center (NSC) BBS in Atlanta, Georgia, at 404-835-6600.

Orchid Technology Inc. (45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0323) has 16- and 256-color drivers available for its ProDesignerII Series of video cards. The 256-color drivers are available as PROI18.EXE, and the 16-color drivers as PROI14.EXE.

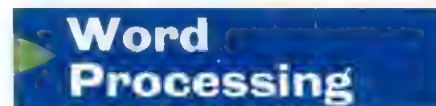
ATI (3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; 415-756-0718) has OS/2 1.3 drivers available for its VGA Wonder cards that ATI engineers say work with OS/2 2.0. The filename is ATIOS2.ZIP. If you have an ATI 8514/ULTRA card, you don't need any special drivers; you can use the 8514 drivers IBM includes in OS/2 2.0.

There's also a generic driver, SVGA_O.ZIP, that's designed to work with video cards using the Tseng Laboratories 4000 video chip. One such card is the Diamond SpeedSTAR (Diamond Computer Systems, 532 Mercury Dr., Sunnyvale, CA 94086; 408-736-2000). Diamond is also in the process of developing its own drivers for its SpeedSTAR and Stealth video cards; the drivers should be available early in 1993.

Several drivers are available for the Trident TVGA cards (Trident Microsystems, 205 Ravendale Dr., Mountain View, CA 94043; 415-691-9211). The file names are T8514.ZIP for the 8514-type drivers, T800V.ZIP for 800-by-600-by-

256 drivers, and T640V.ZIP for 640-by-480-by-260 drivers.

IBM has also promised better SVGA and video accelerator card support in the first major update to OS/2 2.0. By the time you read this, the OS/2 2.0 Service Pack should be available. In addition to a number of new SVGA drivers, the Service Pack will include the 32-bit graphics engine, which should also provide faster video response.—*Joe Salemi*



EDITING EQUATIONS IN WORDPERFECT 5.1

❖ **TIP** WordPerfect 5.1's equation editor (available by typing Alt-F9, then choosing Equation, Create, Edit) is a useful tool for creating equations, but it lacks such basic editing features as search and replace, block copy, and block move. This can be frustrating when you're working with complex equations—particularly if you have several equations in sequence, each similar to the one before.

There is, however, a way to copy equations easily and edit them with WordPerfect's full kit of editing tools. You save the equation to disk as a separate ordinary WordPerfect file, load that file, edit it, save the changed version, and read the file into a newly created blank equation field.

Here's how:

After creating the first equation, save it to disk as a separate file. You must be in the equation editor to do this. Type F10 to save, then enter a disk, path, and filename for the file.

Once you've saved the equation as a file, you can open and edit it just like any other file, and save it when you're done. You can even load it into WordPerfect's document 2 window and edit it while the original document is still loaded in the document 1 window.

After saving the edited formula, go back to the original document, move to the place for the new formula, and create a new equation. Next, type Shift-F10 and either enter the equation filename directly, or type F5 to see WordPerfect's

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Word Processing...Spreadsheets

file-retrieval screen. Once you've retrieved the file, type F7 twice to return to the standard editing screen. The next time you save the document, you'll save the formula as part of the document file.

*Russell W. Dunham
Grand Gorge, New York*

► **PC MAGAZINE:** There are two issues here: copying formulas and editing them. And you may be interested in one and not the other.

For most people who use equations, the ability to copy equations will be of far more interest than the ability to edit them in the WordPerfect editing screen. If you want to copy an entire equation to another part of the document so that you can edit it with the equation editor, you don't have to save it to a file first: Just use WordPerfect's standard editing commands. To copy the equation, type Alt-F3 to reveal codes and block-copy the equation. A quicker alternative, one that you can use for any copying task, is to *delete* the equation, then type F1 and Restore to paste it back in the same place. Now move to the desired destination and type F1 and Restore again to paste another copy of the equation. Use the equation editor to make any needed changes to your copy.

But saving equations as files offers some advantages even if you have no desire to edit the equations in WordPerfect's editing screen. In particular, this will usually be the easiest way to copy an equation from one document to another. And because the equation editor retrieves equation files into the current equation rather than replacing it, you can store and retrieve parts of an equation that you repeat within a given sequence.

If the idea of editing equations in WordPerfect's usual editing screen appeals to you, you can create an equation in the editing screen in the first place, save it as a file, and then load it into an empty equation editor screen. And as Mr. Dunham correctly points out, you can also save an already existing equation to a file, edit and save it as a standard file, and then go back to the equation code you started with and retrieve the edited version. Just be sure to delete the commands for the original equation first,

since the retrieve command will retrieve the file into the already existing equation rather than replace it.

Editing formulas in the standard WordPerfect editing screen gives you the full set of WordPerfect editing tools, but few people are likely to feel comfortable with this, since it requires careful attention to detail and extreme familiarity with the equation commands. As anyone who uses the equation editor already knows, if you make a mistake in the commands for a formula—leaving out a left or right parenthesis, for example—and then try displaying the formula within the equation editor, WordPerfect will display the message, ERROR: Incorrect Format, then leave it to you to figure out what's wrong and correct it.

If you're working within the equation editor, you can minimize the work involved in troubleshooting your equations by redisplaying the equation (with F9) each time you make a change. If you edit the equation as a separate file, however, you lose this ability. And if you've made significant changes in a complex equation, finding and fixing an error can be time-consuming. If this doesn't deter you, you should at least be sure to type F9 after retrieving an equation, to be sure it displays correctly. If it doesn't, you'll then have to find and fix the problem.

—M. David Stone

Spreadsheets

EXCEL 3-D SHADING MACRO

✓ **TIP** While looking for a color scheme for a new group of worksheets, I became fascinated with the 3-D options in Excel's AutoFormat command. These give parts of the worksheet the same three-dimensional look as the buttons in Windows. It was easy enough to figure out how the effect is created, but tedious to apply it to all the different areas of my worksheets. I wrote an "emboss" macro to simplify the job.

To use this macro, select the area you want to format, then press Ctrl-E (or whatever keyboard shortcut you choose to assign). The macro displays a dialog box that lets you choose to recess or lift the area. The dialog box also lets you

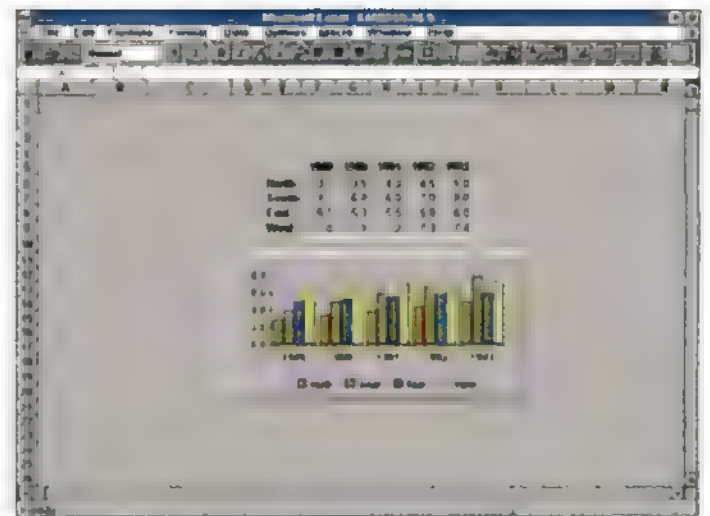


Figure 1: These embossing effects were produced by the macro shown in Figures 2 and 3.

specify the depth of the effect.

After keying in the macro, define the following names on the macro sheet:

Depth = \$K\$10

Effect = \$K\$6

Emboss = \$B\$1

Emboss_Dialog = \$E\$3:\$K\$14

Result = \$B\$3

When defining the name Emboss, indicate that Emboss is a command macro, and supply a keyboard shortcut.

The embossing effect looks best on light gray cells, but it can also be effective with other colors. When using the effect with a chart, it is best to set the chart's border and fill to None so the background color of the underlying cells will show through. It's also best to turn off the area on the legend.

Figure 1 shows examples of the embossing effect. The table in the upper part of the figure uses the "Recess" option, while the chart uses "Lift." In both cases, the depth has been set to "Deep."

*Scott Webb
Florissant, Missouri*

► **PC MAGAZINE:** If there's a source of bright light above your left shoulder, a raised object such as the graph in Figure 1 will have a highlight along its upper and left borders and a dark area (a shadow) along its right and bottom borders. A recessed object such as the table in Figure 1 will have its highlights and shadows in the opposite positions. The more the object is raised or depressed, the thicker these highlights and shadows will be.

As Mr. Webb points out, three-dimensional effects work best in a monochrome presentation, using white for the highlights, dark gray for the shadows, and



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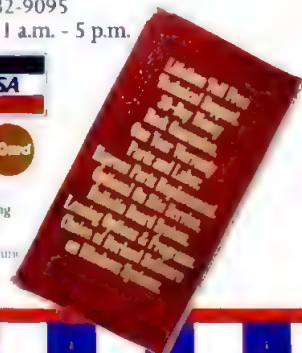
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light gray for recessed or raised areas. Before applying his macro, therefore, you'll want to use the Format | Patterns command to make the relevant parts of your worksheet gray. Note that for best results, the areas surrounding the raised or recessed object should also be gray.

The macro itself (which is listed in Figures 2 and 3) is quite straightforward. The first three instructions display the dialog box, effect a bailout if the user presses Cancel or Esc to leave the dialog box, and assign the name Placeholder to the current selection, enabling the macro to restore the selection when it has finished its business.

The Depth section of the dialog box deposits a value of 1, 2, or 3 into the cell named Depth, depending on whether the user chooses Shallow, Medium, or Deep. The BORDER function, which the macro will ultimately use to create the highlights and shadows, requires an argument value of 1 for a thin solid line, 2 for a medium-weight solid line, or 5 for

a thick solid line. (The other possible values are used for dashed or double lines.) The macro handles these possibilities by assigning the value of Depth directly to the name BorderWidth if Depth is 1 or 2, or assigning a value of 5 to BorderWidth if Depth is 3. This is accomplished via the IF/ELSE.IF/END.IF construct in B6:B10.

A second IF/ELSE.IF/END.IF block, in B11:B17, assigns the appropriate color values to the names BorderTop and BorderBottom. If the user has selected Recess in the dialog box, BorderTop (which will be used for the left as well as the top border) gets 2 (white) and BorderBottom (which will be used for the right as well as the bottom border) gets 16 (dark gray). These values are reversed

if the user has selected Lift.

The SELECT() statement in B18 makes the upper-left cell of the current selection the active cell. The macro needs this instruction to cover the possibility that the user has selected a range by dragging upward and to the left (in which case the lower-right-corner cell will be active) or has navigated within the selection by entering some data.

In B19, the SET.NAME statement now assigns the name UpperLeft to the active cell, while the two SET.NAME statements that follow store the height and width of the

EMBOSS.XLM D1:L14

Partial Listing

	D	E	F	G	H	I	J	K	L
1		Item	X	Y	width	height	text	init/result	
2									
3	Emboss Dialog				330	120	Emboss		
4		1	46	87	88		OK		
5		14	17	9	140	68	Effect		
6		11						1	Effect
7		12					&Recess		
8		12					&Lift		
9		14	173	9	140	68	Depth		
10		11						2	Depth
11		12					&Shallow		
12		12					&Medium		
13		12					&Deep		
14		2	199	87	88		Cancel		

Figure 3: This is the dialog box definition table that is used by the EMBOSS macro.

selection in the names Height and Width.

With all this preparation out of the way, the macro can now proceed (in B22:B29) to apply the appropriate borders to the appropriate cells. The macro uses the SELECT and OFFSET statements to do this, and these statements actually move the cellpointer around within the original selection. If you find the effect of this cellpointer movement distracting, you might want to insert an ECHO(FALSE) statement above this portion of the macro. You can make this insertion anywhere that you wish, from the top of the macro to cell B19. I would suggest putting it directly above B19, so that its purpose is clear.

The macro's remaining instructions reselect the original selection, then delete all the names that were created via SET.NAME statements.

You can download EMBOSS.XLM from the Utilities/Tips forum on PC Mag-Net.—Craig Stinson

EMBOSS.XLM A1:C38

Partial Listing

	A	B	C
1		Emboss	
2			
3	Result	=DIALOG BOX(Emboss Dialog)	start dialog
4		=IF(Result=FALSE,HALT())	if CANCEL then halt
5		=SET.NAME("Placeholder",SELECTION())	save selection
6		=IF(Depth<3)	determine line thickness
7		= SET.NAME("BorderWidth",Depth)	use 1 or 2
8		=ELSE()	
9		= SET.NAME("BorderWidth",5)	use 5
10		=END.IF()	
11		=IF(Effect=1)	
12		= SET.NAME("BorderTop",16)	set color to dark gray
13		= SET.NAME("BorderBottom",2)	set color to white
14		=ELSE()	
15		= SET.NAME("BorderTop",2)	set color to white
16		= SET.NAME("BorderBottom",16)	set color to dark gray
17		=END.IF()	
18		=SELECT()	ensure upper-left active cell
19		=SET.NAME("UpperLeft",ACTIVE.CELL())	capture upper-left
20		=SET.NAME("Height",ROWS(SELECTION()))	height
21		=SET.NAME("Width",COLUMNS(SELECTION()))	width
22		=SELECT(OFFSET(UpperLeft,0,0,1,Width))	select top
23		=BORDER(,,,BorderWidth,,,,BorderTop)	
24		=SELECT(OFFSET(UpperLeft,0,0,Height,1))	select left
25		=BORDER(,BorderWidth,,,,BorderTop)	
26		=SELECT(OFFSET(UpperLeft,Height-1,0,1,Width))	select bottom
27		=BORDER(,,,BorderWidth,,,,BorderBottom)	
28		=SELECT(OFFSET(UpperLeft,0,Width-1,Height,1))	select right
29		=BORDER(,BorderWidth,,,,BorderBottom)	
30		=SELECT(Placeholder)	restore original selection
31		=SET.NAME("Placeholder")	delete names
32		=SET.NAME("BorderWidth")	
33		=SET.NAME("BorderTop")	
34		=SET.NAME("BorderBottom")	
35		=SET.NAME("Height")	
36		=SET.NAME("Width")	
37		=SET.NAME("UpperLeft")	
38		=RETURN()	

Figure 2: This Excel macro produces the embossing effects shown in Figure 1. It lets you choose whether to emboss or recess the area.

Databases

UNDERSTANDING FOXPRO'S FILE FUNCTION

TIP In a FoxPro 2.0 application, before restoring data from a backup disk, I needed to check if the disk in fact contained the backup data. I tried the FILE() function, but it returned .T. (true) even when the disk had no files! It seems that FoxPro's FILE() function will return .T. if it finds the requested file anywhere in

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FoxPro's path (the SET PATH TO path, not the MS-DOS path).

For example, if the CHART.DBF file exists somewhere in FoxPro's path, FILE('A:\CHART.DBF') returns .T. even though the disk in drive A: contains no such file.

The solution I discovered was to remove all path information and then make the backup disk the default drive. For example,

```
OLDPATH=SET('PATH')
SET PATH TO
OLDDEFA=SET('DEFAULT')
SET DEFAULT TO 'A:'
IF FILE('A:\CHART.DBF')
    FOUND=.T.
ELSE
    FOUND=.F.
ENDIF
SET DEFAULT TO &OLDDEFA
SET PATH TO &OLDPATH
```

Of course, the actual program would contain variables for the drive, path, and filename.

*Joseph R. Sevec
Kernville, California*

► **PC MAGAZINE:** The FILE() function is working as designed, although it's confusing. This function is used to find out whether or not a file exists. When you pass the function a file specification, FoxPro first searches for the file as specified. If the file isn't found, it then searches the FoxPro path (the one that you set using SET PATH TO). FoxPro performs this secondary search of the FoxPro path even if you pass it a full file specification by including a drive and directory. This is a source of confusion, since it's contrary to the way some other Xbase products work, and because the FoxPro 2.0 Commands and Functions manual is wrong. The 2.0 documentation says that FoxPro will not search the FoxPro path if you specify a DOS path with the filename. This is not true.

FoxPro's behavior with the FILE() function actually makes some sense. The purpose of the SET PATH TO command is to specify a list of directories for FoxPro to search when it doesn't find a file. So it seems logical that FoxPro would search this path if it can't find the file as

specified using the FILE function. If you don't want FoxPro to search its path, either don't set one at all or save, clear, and restore the path as needed.

Mr. Sevec's solution will work. Recognizing that FoxPro cannot search the FoxPro path if it does not exist, he clears the path temporarily so that the FILE() function will only search for the file as specified. Then he restores the FoxPro path.

An alternative is to issue the command SET COMPATIBLE ON. When COMPATIBLE is ON, FoxPro behaves differently in a number of ways in order to be more compatible with Borland's dBASE IV. Here's how the FILE() function works:

```
IF (file found as specified)
    RETURN .t.
ENDIF
IF (SET COMPATIBLE is OFF)
    IF (file found in SETPATH
        TO path)
        RETURN .t.
    ENDIF
ENDIF
RETURN .f.
```

Notice that the FILE() function does not search the FoxPro path if SET COMPATIBLE is ON.—*Sal Ricciardi*

THE DEL KEY IN PARADOX

✓ **TIP** Paradox makes it so easy to delete a record that records can disappear without the user realizing what has happened. When you press the Del key in Edit or CoEdit mode, a record is deleted. If you see what you have done immediately, Undo can get your data back, but not everyone is alert all the time. The procedure Delkey protects your data by sending the user a wake-up call and asking for confirmation before a record is deleted.

The general idea is to map the procedure Delkey to the Del key instead of the default command DEL. The first IF statement tests to see if Paradox is in a state where a record could be deleted. If Paradox is not in Display mode, is not

Editing or CoEditing, or is in FieldView, then there is no danger of a record being deleted and Delkey returns the default DEL command. Otherwise, Delkey queries the user and returns DEL only if the user responds "y" or "Y".

To install Delkey, first you have to get Delkey into PARADOX.LIB, and then you need to remap the delete key. To create the procedure Delkey, simply play the script DELKEY.SC. Then, to remap the Del key, you have to add the following line to the script, INIT.SC, which Paradox plays every time it starts:

```
SETKEY -83 Delkey()
```

If you follow these simple steps, records will not vanish without user confirmation.

*Barrett L. McCormick
Garran, Australia*

► **PC MAGAZINE:** If you accidentally press the Del key while operating in the Edit or CoEdit modes, Paradox will delete the current record, but you can choose the Undo menu option to restore it. There are times, however, when you may not even notice that you deleted a record, especially if you're fast at the keyboard. Mr. McCormick's procedure adds an extra measure of security since it prompts you before deleting a record (as shown in the screen shot in Figure 4). Answer Y, and the record is deleted. Answer N, and it is left alone.

You use the SETKEY command to bind the Del key to the Delkey procedure. The easiest way to make this happen every time you run Paradox is to



Figure 4: By presenting this confirmation prompt, the Delkey procedure prevents you from accidentally deleting records.

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CIRCLE 112 ON READER SERVICE CARD

The Delkey Procedure

Complete Listing

```
CREATELIB "Paradox"
;-----
; PROC Delkey                                     Paradox
; Create the procedure Delkey to query the user before deleting
; a record
;-----
PROC Delkey ()
; Only change delete function if editing or coediting and not editing
; a field
IF IMAGETYPE() = "Display" AND (SYSMODE() = "Edit" OR
SYSMODE() = "CoEdit") AND ISFIELDVIEW() = FALSE
THEN BEEP
MESSAGE "Do you really want to delete record #",
RECNO(), "? (y/n)"
x = GETCHAR()
; If the user types "y" delete, otherwise quit
IF x = ASC("y") OR x = ASC("Y")
THEN DEL
ENDIF
ELSE DEL
ENDIF
ENDPROC
WRITELIB "Paradox" Delkey

; Sample INIT.SC file
Autolib = "C:\\PDOX\\Paradox"
SETKEY -83 Delkey()
```



Figure 5: This script creates the Delkey procedure. You can use this procedure to prompt the user before deleting a record in Edit or CoEdit mode. Note the sample INIT.SC file.

place the statement in your INIT.SC file, which Paradox runs automatically whenever it starts up.

Note too, that you need to include the Autolib statement shown in the sample INIT.SC file at the bottom of Figure 5 so that Paradox will automatically look in your PARADOX.LIB file to locate the Delkey procedure.

You create the Delkey procedure by running the script shown in Figure 5, which tokenizes the Delkey procedure and then places it in the PARADOX.LIB file.

You can download the Delkey procedure from PC MagNet. Look for DELKEY.SC in the Databases section of the Utilities/Tips Forum.—*Sal Ricciardi*

Graphics

CROSS-COLUMN ALIGNMENT

❓ I produce our company's newsletter once a month, and I literally spend hours trying to get the type to align across multiple columns. Can PageMaker 4.0 automate this process?

*Bill Manning
Tarrytown, New York*

► **PC MAGAZINE:** The answer is a definite yes...and no. PageMaker 4.0 does contain some powerful tools that can help you to align type across columns. But ultimately you'll have to do some old-fashioned math and build your newsletter on a consistent leading grid.

Think of a leading grid as the underlying structure of your page. Every element in your newsletter—including body copy, headlines, subheads, and even pictures—should line up to this grid. The leading grid should always be based on the smallest common denominator—which means the leading increment used for body copy.

Here's how it works: Decide on the size and line spacing for body copy, such as 12 point Palatino on 15 points of leading. Now derive all the other measurements and type styles in your document from this base. For example, you might specify a headline style of 24 point Palatino on 30 points of leading. Remember that *all* spacing attributes, including things like spaces before and after paragraphs, must add up to a multiple of 15 points.

You can—and should—customize PageMaker's vertical ruler to match your leading grid. This may seem a minor

point, but when used in conjunction with the Snap to Rulers option, it's actually a very powerful feature. First, open the Preferences dialog box (from the Edit menu). Instead of inches or centimeters, choose the Custom option for the Vertical ruler. In the edit box to the right, type in the leading you're using for body copy. To continue with our earlier example, you'd enter 15 points. Remember to click OK to accept these settings. Now, whenever you invoke the Snap to Rulers command (found on the Options menu), PageMaker will automatically align text and picture elements to a 15-point vertical grid.

A more sophisticated—and therefore more difficult to master—feature is the Align to Grid option. There's little chance you'll stumble across this function accidentally, because it's hidden deep within the Paragraph specification dialog box, shown in Figure 6. Follow these steps to include the Align to Grid function as part of a named style:

Choose the Define Styles command from the Type menu, then click the New button; remember to type an appropriate stylename into the edit box. Now click the button identified as "Para...". This will open up the Paragraph specifications dialog box. (Note: You can reach the Paragraph dialog box directly from the Type menu, but if you do, the changes you make will only affect the currently selected paragraph and will not be saved as a named style.)

In the Paragraph dialog box, click the Rules button. In the Rules dialog box, click the Options button. And in the Options dialog box, turn on Align to Grid and enter the appropriate grid size in points. Then click OK four times (or use the shortcut by holding down the Alt key as you click OK) to accept these settings and return to the working document.

There are several things about the Align to Grid option that are important to understand. Even though you must go through the Paragraph Rules dialog box to access the Align to Grid command, the two options are unrelated. It isn't necessary to include a rule in the paragraph style in order to use the Align to Grid option.

More important, the Align to Grid option doesn't affect the paragraph to

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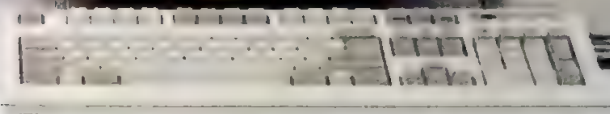
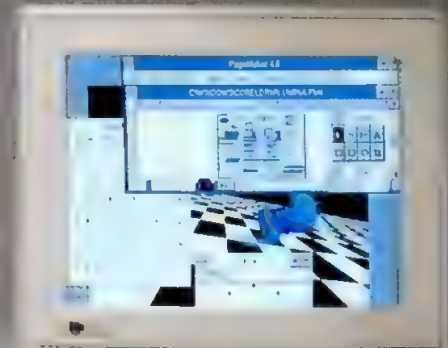
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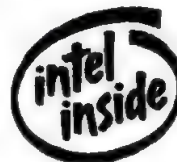
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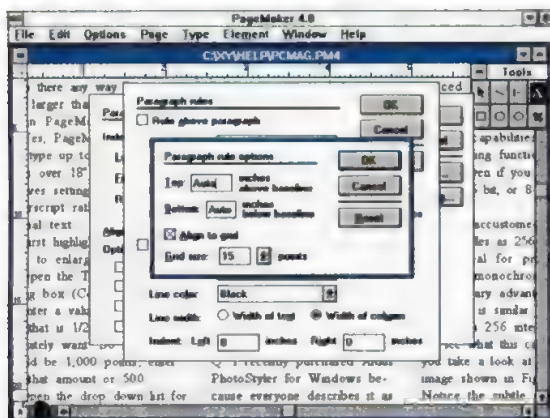


Figure 6: PageMaker's Align to Grid option lets you easily create text that is aligned across columns.

which it is assigned—it affects the following paragraph. Basically, the Align to Grid option will add space after the current paragraph so that the next paragraph can start in sync with the leading grid. So if the current paragraph is set on 24 points of leading, the Align to Grid option will add 6 points of extra space—for a total of 30 points (a multiple of the 15-point leading grid).

These three techniques—a uniform leading grid, customized rulers, and the Align to Grid option—aren't totally automatic. For example, if you use the Align to Grid option indiscriminately you'll create awkward gaps in the text flow. But if you're willing to make the initial effort, you can easily generate a professional-looking newsletter complete with cross-column alignment.

—Luisa Simone

Networking

SHARING A PHONE LINE

❷ Is there a way I can make my modem and standalone fax share one phone line, even though both devices will attempt to answer incoming calls? If so, what will I need?

Leonard Schellgren
Minneapolis, Minnesota

► **PC MAGAZINE:** You need a *line manager*—a device that, once connected between the telephone line and your equipment, will pick up in response to a ring, listen for a while, then route the call. If

you think this sounds too simple, though—you're right! What happens during the listening period makes a tremendous difference.

The least sophisticated type of line manager allows a telephone and fax machine to share a single line. If, within three to four seconds of answering, the manager hears the calling (CNG) tone sent by an originating fax machine, it rings the receiving fax. Otherwise, it rings the telephone. Since a person calling you might interpret silence as an incomplete

call and hang up, the manager—while listening for the CNG tone—also supplies a ring to the caller. Calling fax machines don't listen for the ringing tone, they simply send CNG tone immediately after dialing.

If you only need to share the line between a modem and a fax machine, you can use one of these relatively simple devices. Since, as with a calling person, a calling data modem is silent, you can attach your modem to the line manager port meant for a telephone. Anyone dialing your modem, however, must know to set their communications software so that it expects 7-10 rings before an answer.

The situation becomes much more complex if you want to share a line between an answering modem and the telephone. Unlike an originating fax machine, which issues a tone when the other end answers, modems and people—as noted above—remain silent, so a fax line manager can't differentiate between them. The most common solution requires that the calling modem dial extra digits (usually the equivalent of a number 4 on the touch pad) just after the line manager answers. The manager recognizes these tones and responds by connecting to the answer modem. The technique is tricky because calls made to different places or at different points in the day take varying periods of time to connect, so for dialing in you must experiment with the number of commas you put in your dialing string (to create a pause) and the number of times you send the digit 4.

Alternatively, you can program the calling and answering modems to use each other's tones. That is, the calling modem immediately issues the set of tones defined as "answer tones" as soon as it dials, and the answering modem uses the set of tones defined as "calling tones" when it finally picks up the line. This technique isn't as sensitive to variations in the time needed to complete a call, but the modem commands are more complex. In either case, to dial in you'll have to program your communications soft-

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ware so that the modem makes some noise, enabling the line manager to differentiate between voice and modem calls.

A word of caution—not all line managers are compatible with all modems. The modem looks for a ring signal composed of a sine wave with a 90 volt amplitude and a 20 Hertz frequency, which most line managers try to emulate using a digital approximation. Some modems, though, don't respond to a ring simulated this way. If yours doesn't, return the line manager for another model. It's not the modem's fault.

Command Communications (800-288-3491 or 303-751-7000) markets a number of different line managers. The simplest voice/fax devices start at \$79.95 and the top of the line TF-555 lists for \$179.

The TF-555 can handle a variety of different calling situations. Command Communications has a strong free technical support program, and the technicians can call your TF-555 and remotely program it to meet your needs.

—Frank J. Derfler, Jr.

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HICOLORS.BAS

Complete Listing

```

DEFINT A-Z

'$INCLUDE: 'QB.BI'

DECLARE SUB FPrint (Text$, Row, Col, Fg, Bg)
DECLARE SUB SetBackIntens (Board, Setting)

DIM SHARED Regs AS RegType

DIM Colors$(0 TO 15)
FOR X = 0 TO 15
    READ Colors$(X)
NEXT
DATA Bright White, Yellow, Bright Purple, Bright Red, Bright Cyan
DATA Bright Green, Bright Blue, Grey, White, Brown, Purple, Red
DATA Cyan, Green, Blue, Black

MDAHerc = 0
CGA = 1
EgaVga = 2

BlinkOn = 0
BlinkOff = 1

CLS
CALL SetBackIntens(EgaVga, BlinkOff)

Title$ = "High intensity background colors in QuickBASIC 4.5"
FPrint Title$, 4, 40 - LEN(Title$) \ 2 + 1, 15, 0

FOR Row = 1 TO 15

    FOR PlaceBar = 0 TO 15

        StartPos = ABS(Row - 2) + 1
        Item$ = Colors$(15 - PlaceBar)

        IF Row < 2 OR Row > LEN(Item$) + 1 THEN
            Text$ = " "
        ELSE
            Text$ = " " + MID$(Item$, StartPos, 1) + " "
        END IF

        IF PlaceBar > 7 THEN Switch = 1

        IF Switch = 1 THEN
            Fg = 31 - PlaceBar
        ELSE
            Fg = 15 - PlaceBar
        END IF

        Bg = PlaceBar
        FPrint Text$, Row + 6, 1 + PlaceBar * 5, Fg, Bg

    NEXT

    Switch = 0

    WHILE LEN(INKEY$) = 0: WEND

    CALL SetBackIntens(EgaVga, BlinkOn)

    SUB FPrint (Text$, Row, Col, Fg, Bg) STATIC

        LOCATE Row, Col
        COLOR Fg, Bg
        PRINT Text$:

    END SUB

    SUB SetBackIntens (Board, Setting) STATIC

        CONST MDAHerc = &H3B8 'the MDA/Hercules port address
        CONST CGA = &H3D8 'the CGA port address

        IF Setting THEN 'exchange blinking for high-intensity
            SELECT CASE Board
                CASE 0 'monochrome adapter
                    OUT MDAHerc, 9
                CASE 1 'CGA adapter
                    OUT CGA, 9
                CASE 2 'EGA/VGA adapter
                    Regs.AX = &H1003
                    Regs.BX = 0
                    CALL Interrupt(&H10, Regs, Regs)
            END SELECT
        ELSE 'restore blinking
            (normal setting)

            SELECT CASE Board
                CASE 0
                    OUT MDAHerc, &H29
                CASE 1
                    OUT CGA, &H29
                CASE 2
                    Regs.AX = &H1003
                    Regs.BX = 1
                    CALL Interrupt(&H10, Regs, Regs)
            END SELECT
        END IF

    END SUB

```



Figure 7: This combined subroutine and demonstration shows how to exchange a flashing foreground for a high-intensity background.

Languages

USING HIGH-INTENSITY COLORS

TIP When I added a color-configuration routine to a program, I wanted to allow an option to select high-intensity background colors. On EGA and VGA systems, calling the video BIOS with AX set to &H1003 and BX equal to 0 gives up foreground blinking in exchange for a high-intensity background. Setting BX to 1 reenables blinking.

For systems with monochrome (MDA), Hercules, or CGA adapters, a different method is required to enable high-intensity backgrounds: writing di-

rectly to the port to access the video mode control register. The port for CGA adapters is &H3D8; the monochrome and Hercules adapter port is &H3B8.

The combined demonstration and subroutines in Figure 7 display all 16 background colors. I wrote the program for use with EGA or VGA adapters, but you can change the variable used in the call to SetBackIntens to either CGA or MDAHerc to test it with those display types. You can download HICOLORS from PC MagNet as HICOLO.BAS.

*Richard Weshenfelder
Billings, Montana*

► **PC MAGAZINE:** BASIC programmers have long known that adding 16 to the foreground COLOR argument will make the foreground flash. But a flashing effect

is too distracting for most applications. By using the techniques shown here, you can tell the PC's display adapter to instead make the background color bright when values greater than 15 are used for the foreground color.

However, before you use these techniques with monochrome or CGA adapters, you should be aware of the following: Sending incorrect values or specifying the wrong port can possibly damage the monitor. Therefore, you need to be certain about the type of display that is connected before you use these OUT statements, and also be careful to enter the values exactly as shown. Since many people now have at least an EGA, it is safest if you limit your program to use only the CALL INTERRUPT portion of this code.—*Ethan Winer* □

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Jim Seymour, PC Magazine, January 26, 1993

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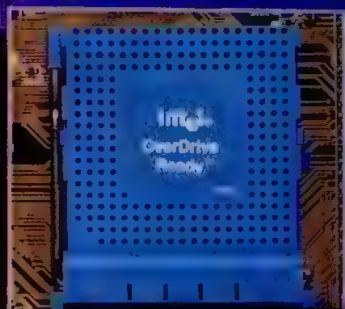
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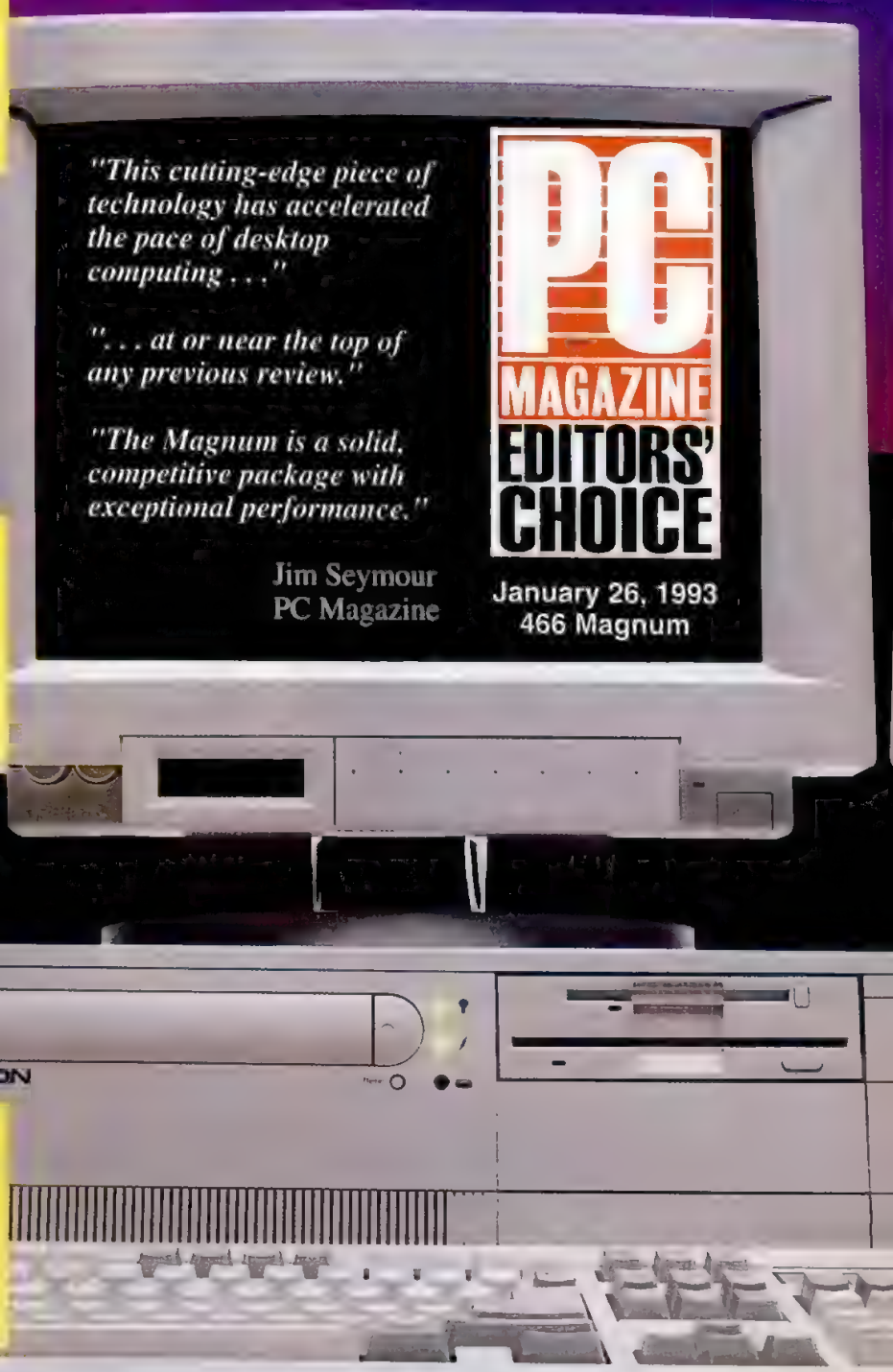
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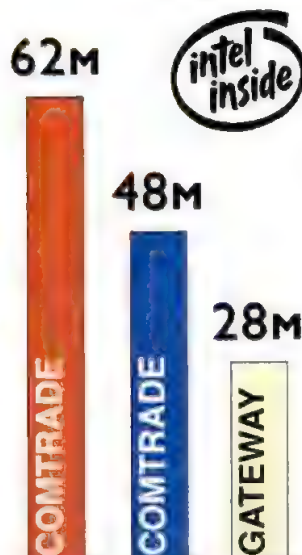


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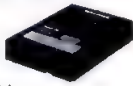
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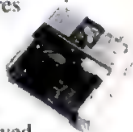


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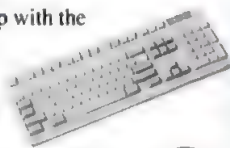
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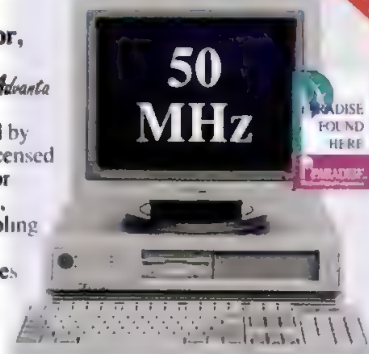
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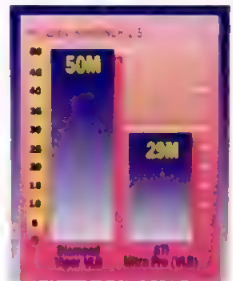
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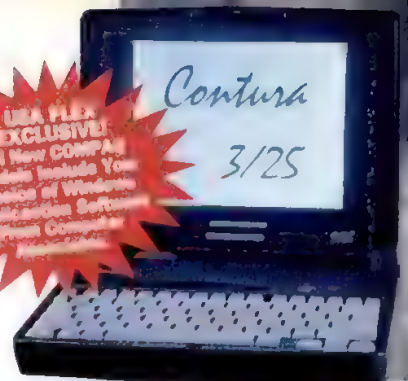
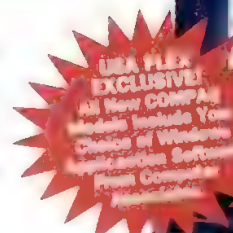
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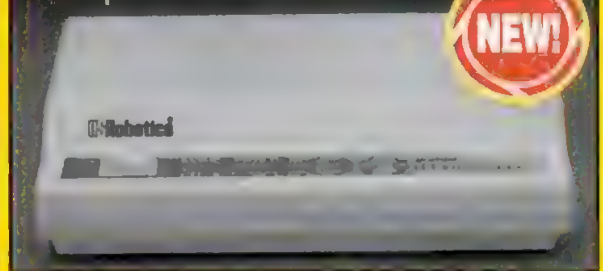
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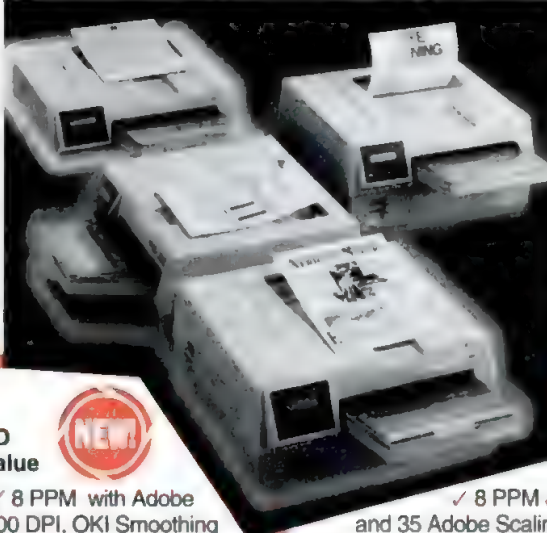
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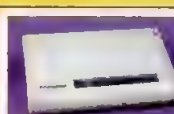
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This new PC compatible, compact printer takes up less space on your desk top than a sheet of paper, yet provides full function capabilities. It consistently delivers crisp, 300dpi professional text and graphics for office-quality output.

AutoMap for Windows \$55

Take the trouble out of road trip planning with this colorful, computerized road atlas for your PC. It has easy-to-read map displays and easy-to-follow turn instructions. Forget about fumbling with fold-out maps, and troublesome mileage charts, just tell AutoMap where you're starting, and where you want to go.

AutoMap DOS \$49

AutoMap for Windows upgrade \$45

Hitachi SuperScan 15 \$499

A compact, high performance 15" monitor that is the perfect choice for windowing, business programs, presentation graphics and general applications. The advanced flat, square, anti-glare CRT technology is noticeably easier on your eyes. Automatically syncs at every graphic standard from VGA to 1024 to 768, 28 mm dot pitch.

SuperScan 17" \$ 999

SuperScan 20" \$1499

\$295

SureTrak helps you plan, schedule, visualize, and control your important projects. Its superb graphics help you plan the project, predict problems, analyze alternatives, and convey your recommended approach to team members and clients. Gantt and PERT charts, and precise resource and cost plans can be customized to make the perfect presentation.

CD & MULTIMEDIA

Pinnacle Micro Internal CD-ROM Drive \$229

The Pinnacle Micro Internal CD-ROM drive uses standard 12cm CD-ROM disks. The drive assembly can sustain a raw data transfer of 4.3 Mbits per second of media. The drive includes supplementary audio outputs to play music and audio CD-ROM disks. Package includes PC bus interface board which supports XT systems and above, and the World Atlas CD-ROM.

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BattleChess	45
Carmen SanDiego	59
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Book of Mammals	49
MS Multimedia Beethoven	55
MS Multimedia Bookshelf	129
PC SIG Shareware CD	99
U.S. Atlas w/ AutoMap	69
World Atlas	49

Microsoft Encarta \$245

Encarta is a twenty-eight volume encyclopedia on CD-ROM with over 17,000 multimedia elements including pictures, animation and audio. Encarta features over 25,000 articles, samples 45 languages and much more!

CD-ROM Hardware

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Pinnacle Internal CD-ROM w/Atlas	319
Sony Int. CD Drive Kit	349
ATI Stereo FX	109
Creative Labs	
Multimedia Kit CD-ROM & SB Pro	559
Sound Blaster	95
Sound Blaster Pro (stereo & MIDI)	179
Video Blaster	319
Media Vision	
ProAudio Spectrum Plus / 16	179/197

Colorado

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DJ-20 80-240mb Int. Tape	259
External Kit w/AB11	99
Tracker 120 mb / 250 mb	359 / 439

DTC

6282-24 24mb/sec transfer rate	125
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HardCard IXL 105mb 9 ms 16bit	399

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Action Laser 1500 \$849

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= Windows Software

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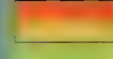


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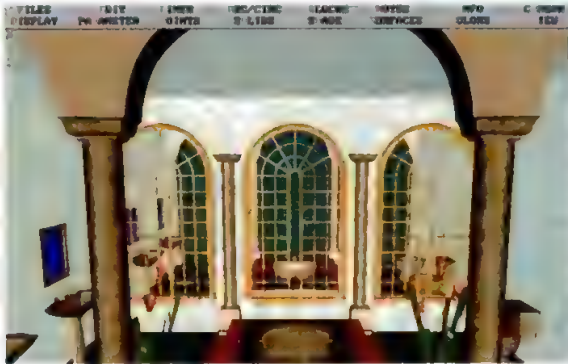
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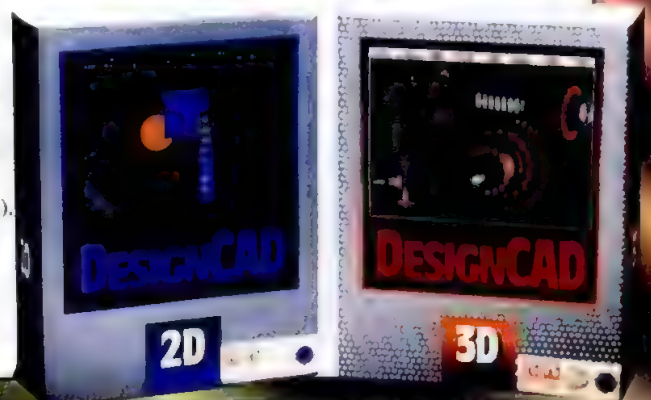
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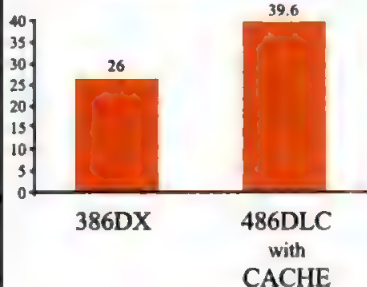


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AS EASY AS	ASEASY.ZIP ASADOC.ZIP	Blindingly fast Lotus 1-2-3 clone with extra features like depreciation and interpolation.	PBSAPPS LIB 6 DOS Applications
Catacomb Abyss	CATAB1.ZIP CATAB2.ZIP CATAB3.ZIP	A role-playing tale of wizards, magic and fantasy trips into other dimensions. (May be too graphic for some children.)	PBSARC LIB 3 DOS Games
Multimedia Workshop	MMWS1.ZIP MMWS2.ZIP	Create multimedia presentations in mono, CGA, EGA or VGA. Includes 10 samples of digitized speech.	PBSAPPS LIB 6 DOS Applications
Print Screen Manager	PSMAN.ZIP	Inexpensive alternative to screen capture utilities lets you direct screen prints to the printer, a disk file or the clipboard.	PBSAPPS LIB 4 Windows Utilities
GetBack	GTBAK.ZIP	Easy-to-use backup/restore program does full or incremental backups, compresses output, and more.	PBSAPPS LIB 3 DOS Utilities
Cedar Island Link	CILINK.ZIP	Full-featured communications software with pass-through mouse control (use your mouse to select items on the remote system's menus).	PBSAPPS LIB 12 Communication
DOS Extensions for Pros	DOSEXT.ZIP	Includes DOS 5 Help system information. Set up to be easily used with DOSSHELL. Requires DOS 3.0 or higher.	PBSAPPS LIB 3 DOS Utilities
Address Manager	ADMAN1.ZIP ADMAN2.ZIP	Windows application for organizing addresses, phone numbers, birthdays, anniversaries, Christmas card lists, etc.	PBSAPPS LIB 7 Windows
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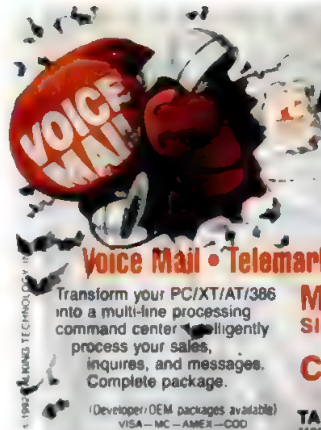
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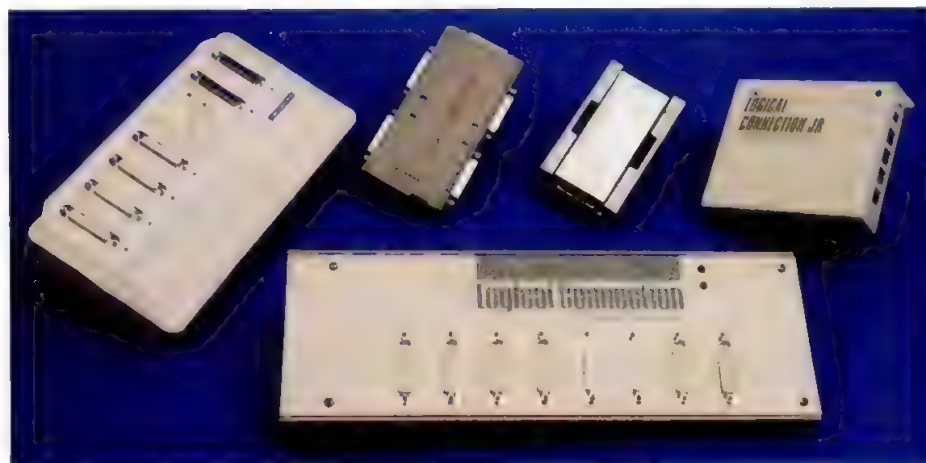
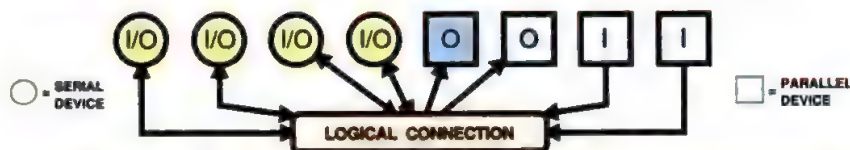
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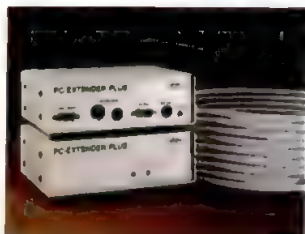
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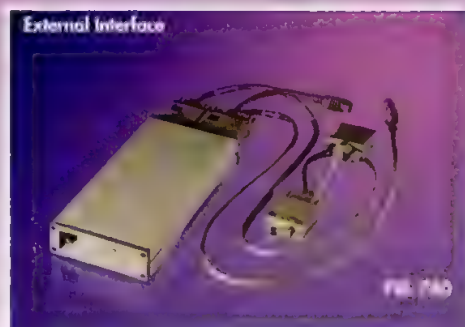
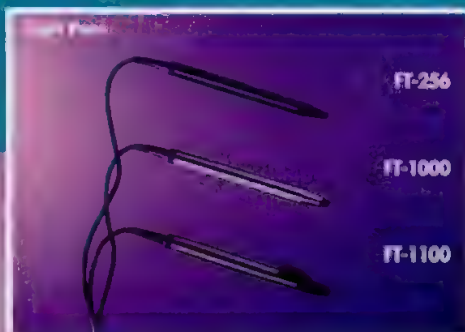
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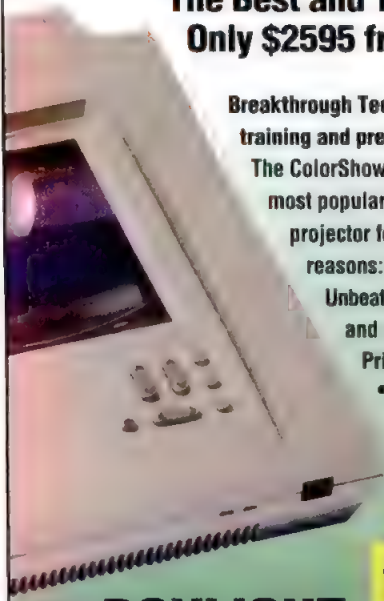
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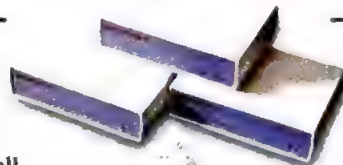
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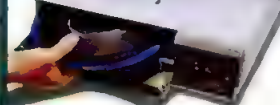
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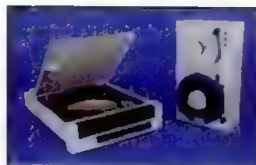
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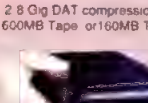
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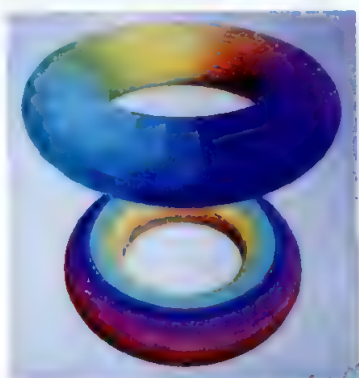
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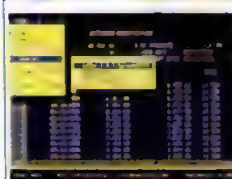
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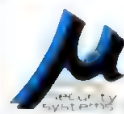
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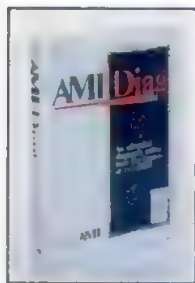
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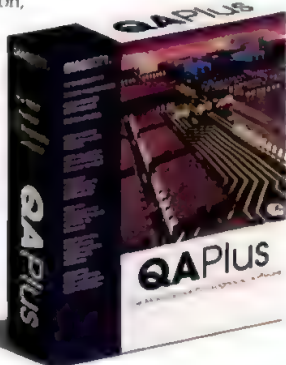


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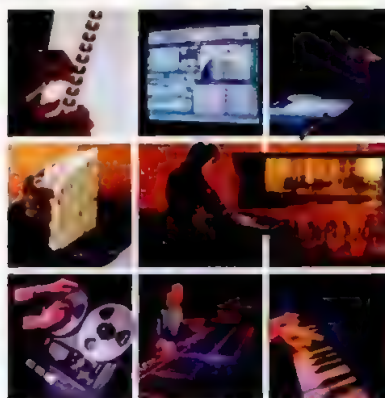
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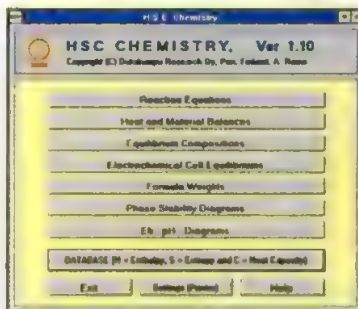
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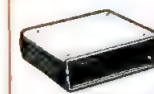
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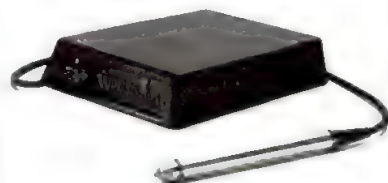
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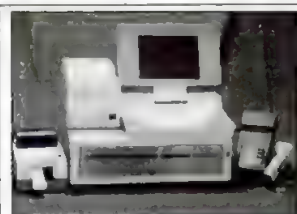
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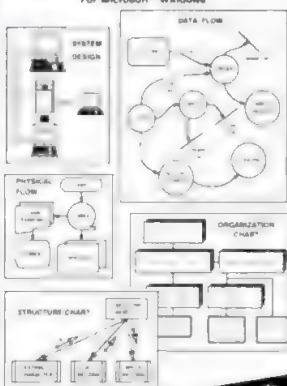
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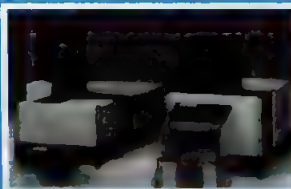
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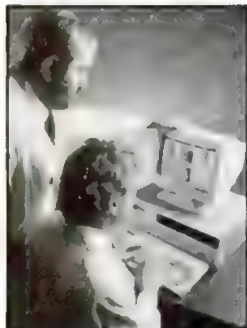
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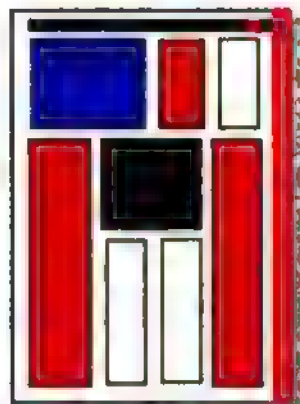
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1. Do you work in a DP/MIS dept.?

01 ☐ Yes 02 ☐ No

2. Please indicate your company's or organization's primary business activity: (Check one only)

01 ☐ Manufacturer Computer Equip., Computers, Software02 ☐ Manufacturer—Aerospace03 ☐ Manufacturer—Other04 ☐ Systems House05 ☐ Computer Consultant06 ☐ Computer Retailer/VAR/VAD Distributor07 ☐ Communications08 ☐ Finance/Banking/Insurance/Real Estate/Accounting09 ☐ Education10 ☐ Government—Federal11 ☐ Government—Non-Federal12 ☐ Research and Development13 ☐ Data Processing/Computer Service14 ☐ Health/Medical/Legal Service15 ☐ Engineering/Architecture16. ☐ Agriculture/Construction/Mining/Oil/Transportation/Utilities17 ☐ Non-Computer Retailer/Distributor18 ☐ Other Business or Service

3. Please indicate your primary business function: (Check one only)

01 ☐ DP/MIS02 ☐ Systems, Programming03 ☐ Communications04 ☐ Engineering05 ☐ Res./Dev./Scientific06 ☐ Accounting/Finance07 ☐ Computer Consulting08 ☐ Purchasing09 ☐ Operations10 ☐ Production11 ☐ Education/Training12 ☐ Marketing/Sales13 ☐ Medical/Legal14 ☐ Admin./Mgmt.99 ☐ Other

4. Is your company a reseller?

01 ☐ Yes 02 ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

01 ☐ 10 or less 03 ☐ 26-9902 ☐ 11-25 04 ☐ 100 or more

6. Are there any PCs in your office? (Check all that apply.)

01 ☐ Linked to mainframe02 ☐ Linked to mini03 ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

01 ☐ IBM or Compatible PCs02 ☐ IBM or Compatible Mainframes03 ☐ IBM or Compatible Minis04 ☐ Macintosh05 ☐ CD-ROM06 ☐ Windows

8. Do you plan to buy any PC products?

01 ☐ Now03 ☐ In 7 to 12 months02 ☐ In 4 to 6 months 04 ☐ No definite plans

9. Number of Employees in your entire company:

01 ☐ 25 or less 02 ☐ 26-99 03 ☐ 100-499 04 ☐ 500-999 05 ☐ 1000 or more

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01. ☐ Yes 02. ☐ No

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01. ☐ Manufacturer Computer Equip Computers, Software
02. ☐ Manufacturer—Aerospace
03. ☐ Manufacturer—Other
04. ☐ Systems House
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17. ☐ Non-Computer Retailer/Distributor
18. ☐ Other Business or Service

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03. ☐ Communications
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05. ☐ Res./Dev./Scientific
06. ☐ Accounting/Finance
07. ☐ Computer Consulting
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09. ☐ Operations
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12. ☐ Marketing/Sales
13. ☐ Medical/Legal
14. ☐ Admin./Mgmt.
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02. ☐ Linked to mini
03. ☐ Networked together

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04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

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Advertisers' Index COMPANIES

Reader Service No.	Advertiser	Page
293	3 Com Corporation.....	246-247
034	Acer America	96-97
162	American Power Conversion.....	269
025	American Small Business Computers.....	395
209	Ariel Design Inc	348
336	Arlington Computer Products.....	390
254	Artisoft Inc	203
008	ASP Computer Products.....	88
323	AT&T Paradyne	47
228	ATI Technologies Inc.....	168-169
012	Austin Computer Systems.....	13-15
012	Austin Computer Systems.....	147
012	Austin Computer Systems.....	149
111	Automap Inc	141
387	Bitwise	205
220	Borland International.....	6
295	Borland International.....	112-115
328	Buffalo Products.....	398
292	Caere Corporation	104
190	CallSoft.....	80
388	CallSoft.....	83
*	Canon Computer Systems.....	248
187	Canon, U.S.A	260
079	Central Point Software	78-79
073	Colorado Memory Systems.....	36
137	Compaq Computer.....	86
128	CompuAdd Express	153
128	CompuAdd Express	162-163
126	CompuAdd	67-70
205	Compuclassics.....	379
144	Compudyne.....	144-145
132	Compudyne.....	256-257
300	Computability	374-375
400	Computer Associates	5
348	Computer Associates	43
109	COMPUTER DISCOUNT WAREHOUSE.....	382-383
177	Computer Express	378
009	Computer Library.....	298
158	Computer Library.....	315
033	Computer Library.....	404
316	Comtrade	367
315	Concentric Data Systems.....	271
011	Corel Corporation	98
389	DCA.....	23
*	Dell Computer Corporation	C5-C8
*	Dell Computer Corporation	120-121
*	Dell Computer Corporation	234-235
*	Dell Computer Corporation	266-267
*	Dell Computer Corporation	292-293
002	Digital Products Inc.....	100
150	Dresselhaus Computer Pro.....	200
168	DUSTIN DISCOUNT SOFTWARE.....	332

Reader Service No.	Advertiser	Page
347	DUSTIN DISCOUNT SOFTWARE.....	340-341
362	Eastman Kodak Company.....	125
119	Edge Technology.....	363-366
*	Epson America.....	20-21
305	Expo Tech	357-359
*	FASTMICRO.....	131-138
352	FASTMICRO.....	382-383
382	First Source International	376-377
*	Gateway 2000.....	207-210
277	Global Horizons, Inc	391
342	Grid Systems Corporation	106-107
391	H.Co Memory Upgrades	399
*	Hard Drives International.....	338-339
275	Hyundai Electronics	57
066	IBM Corporation.....	179-182
*	IBM Personal Software Products.....	213-216
*	Insight Distribution Network.....	334-337
306	Intel Corporation.....	150-151
*	Intuit, Inc	89
378	Iomega	16-17
106	Kingston Technology	45
370	Kyocera Electronics.....	65
019	L.A. Trade.....	394
143	Lotus Development Corporation	61-63
*	Lotus Development Corporation	102-103
*	Lotus Development Corporation	154-157
*	Lotus Development Corporation	239
*	Lotus Development Corporation	241
*	Lotus Development Corporation	243
*	Lotus Development Corporation	244-245
263	Macola, Inc	227
067	Mag Innovision	26-27
365	Manugistics.....	177
291	MapInfo Corporation	255
154	Mathsoft Inc	183
093	Media Vision	51
093	Media Vision	53
085	Micro Center	101
005	Micro Solutions Computer Products.....	193
361	Micrografx.....	55
119	Micron Computers	363-366
*	Microsoft	2-3
*	Microsoft	72-73
*	Microsoft	173-175
*	Microsoft	220
*	Microsoft	228-229
*	Microsoft	285
225	MicroWarehouse	309-310
010	Midwest Computer Works	396
112	Mitac	354-355
283	Nanao Corporation.....	242
217	NEC Technologies	84-85

Reader Service No.	Advertiser	Page
217	NEC Technologies	94
153	NEC Technologies	C2-C4,p1
*	Northgate Computer Systems	319-324
056	Okidata	167
133	On-Track Computer Systems.....	82
*	Pacific Data Products, Inc	76
*	Pacific Data Products, Inc	192
145	Pacific Wave Technology.....	387
029	PC Brand	194-197
*	PC Connection	250-253
080	PC Power & Cooling.....	265
199	PC Zones.....	392-393
092	PCs Compleat.....	350-352
345	PCs Compleat.....	361
026	Personics.....	4
089	PK Ware	259
148	Primavera Systems	58
296	SAMTRON	18
*	Scitor Corporation	143
*	Seagate Technology.....	118
213	Sigma Data	219
212	SoftMaker.....	282
*	Software Publishing.....	10-11
*	Software Publishing.....	272-273
*	Swan Technologies Inc.....	275-276
186	Symantec Corporation.....	28
045	Tangent Computer, Inc	344
001	Tektronix Inc	41
206	TELEMART.....	397
353	Texas Instruments.....	201
330	Thomas Conrad Corporation.....	117
379	Toshiba America	74-75
121	Tri-Star Computers.....	346
189	USA Flex.....	368-369
210	USA Flex.....	370-371
051	USA Flex.....	372-373
055	Video Seven	198
*	WordPerfect Corporation	129
087	Worldwide Technologies	386
*	Zenith Data Systems	126-127
036	Zeos Int'l	24-25
115/035	Zeos Int'l	33
063	Zeos Int'l	34-35
125	Zeos Int'l	90-91
038	Zeos Int'l	92
151	Zeos Int'l	32a-32f
070	Ziff Desktop Information.....	402-403

* No Reader Service #. Please Call Advertiser For Information.

Advertisers' Index PRODUCTS

Reader Service No.

Company

Product

Page

ACCELERATOR BOARDS			
228	ATI Technologies Inc.	ATI Graphics Accelerators	168-169
051	USA Flex	Peripherals	372-373

ACCOUNTING SOFTWARE			
•	Intuit, Inc.	Quickbooks	89
263	Macola, Inc.	Accounting Software	227

ADD-ON BOARDS			
382	First Source International	Memory	376-377
108	Kingston Technology	Data Card	45
213	Sigma Data	Upgrades	219

ANTI-VIRUS SOFTWARE			
133	On-Track Computer Systems	Network Data Recovery Utility	82

BACKUP SOFTWARE			
079	Central Point Software	Windows Utilities	78-79
005	Micro Solutions Computer Products	Tape Backup, Disk Drives	193

BOOKS			
009	Computer Library	Data Sources	298
•	Microsoft	Books	2-3
•	Microsoft	Microsoft Press	220

CAD/CAM			
025	American Small Business Computers	DesignCAD Professional	395
•	Pacific Data Products, Inc.	Protracer	192

CD-ROM			
300	Computability	Mail Order	374-375
158	Computer Library	Computer Select	315
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
382	Eastman Kodak Company	Photo CD	125
005	Micro Solutions Computer Products	CD-ROM	193
153	NEC Technologies	CD-ROM	C2-CAp1

CHIPS/PROCESSORS			
328	Buffalo Products	Cyrix Chips	398
306	Intel Corporation	Overdrive Processors	150-151

CO-PROCESSORS			
213	Sigma Data	Upgrades	219

COMMUNICATIONS SOFTWARE			
263	Macola, Inc.	Communications Software	227
133	On-Track Computer Systems	Network Data Recovery Utility	82

COMPUTERS/COMPATIBLES			
034	Acer America	PC Compatibles	96-97
208	Anel Design Inc.	Computers	348
012	Austin Computer Systems	Austin Desktop PCs	13-15
012	Austin Computer Systems	Austin Desktop PCs	147
012	Austin Computer Systems	Austin Desktop PCs	149
126	CompuAdd	CompuAdd Systems	67-70
128	CompuAdd Express	CompuAdd Express Systems	153
128	CompuAdd Express	CompuAdd Express Systems	162-163
144	CompuDyne	CompuDyne Desktops	144-145
109	COMPUTER DISCOUNT WAREHOUSE	Hardware	382-383
310	Comtrade	Systems	367
•	Dell Computer Corporation	Dell Systems	C5-C8
•	Dell Computer Corporation	Dell Systems	120-121
•	Dell Computer Corporation	Dell Systems	234-235
•	Dell Computer Corporation	Dell Systems	266-267
•	Dell Computer Corporation	Dell Systems	292-293
119	Edge Technology	PC's	363-366
305	Expo Tech	486 DX2/50 Mhz, 486 SX/25 Mhz	357-359
•	FASTMICRO	Systems	131-138
352	FASTMICRO	Hardware/Software	382-383
•	Gateway 2000	PC's	207-210
277	Global Horizons, Inc.	Components/Systems	391
342	Grid Systems Corporation	GRd Desktops	106-107
275	Hyundai Electronics	Notebooks	57
068	IBM Corporation	PS/Valuepoint Direct	179-182
085	Micro Center	WinBook Notebook	101
119	Micron Computers	PC's	363-366
010	Midwest Computer Works	Hardware, PC's, Monitors	396
217	NEC Technologies	Desktop PC's	84-85
•	Northgate Computer Systems	PC's, Notebooks	319-324
145	Pacific Wave Technology	Computers	387
029	PC Brand	Mail Order, PC's	194-197
092	PCs Complete	Computers	350-352
345	PCs Complete	Computers	361
•	Swan Technologies Inc.	PC's	275-276
045	Tangent Computer, Inc.	486's, Servers	344
121	Tri-Star Computers	Systems	346
189	USA Flex	USA Flex Systems	368-369
•	Zenith Data Systems	PC's	128-127
036	Zeos Int'l	Zeos Contenda	24-25
115/035	Zeos Int'l	Zeos Z-Card, Z-Quote	33
063	Zeos Int'l	Zeos 486 Eisa	34-35
125	Zeos Int'l	Zeos Freestyle SL/Notebooks	90-91
038	Zeos Int'l	Zeos Color Notebooks	92
151	Zeos Int'l	Zeos Upgradable Systems	32a-32f

DATA BASE MANAGERS			
228	Borland International	db 2.0	6
295	Borland International	Paradox for Windows	112-115

Reader Service No.

Company

Product

Page

315	Concentric Data Systems	R&R Relational Report Writer	271
•	Microsoft	Fox Pro for Windows	173-175
•	Software Publishing	Superbase	272-273

DATA COMPRESSION SOFTWARE			
089	PK Ware	PK Zip/PK Lite	259

DISK BACKUP & TAPE DRIVES			
073	Colorado Memory Systems	Trakker	36
300	Computability	Mail Order	374-375
378	Omega	21MB Drive, Omega Tape	16-17
005	Micro Solutions Computer Products	Tape Backup, Disk Drives	193

DISPLAYS/MONITORS/TERMINALS			
338	Arlington Computer Products	Mail Order	390
067	Mag Innovation	High Resolution Monitors	26-27
010	Midwest Computer Works	Monitors	358
283	Nanaco Corporation	High Resolution Monitors	242
296	SAMTRON	Monitors	18
210	USA Flex	Mail Order/Peripherals	370-371

ENTERTAINMENT SOFTWARE			
111	Automap Inc.	Automap	191

FLOWCHARTING			
361	Micrografx	ABC Flowchart 2.0	55

FONT CARTRIDGES			
002	Digital Products Inc.	Print Director	108

FONT SOFTWARE			
212	SoftMaker	Font Software	282

GRAPHICS SOFTWARE			
011	Coral Corporation	Coral Draw	98
•	Lotus Development Corporation	Freehand Graphics for Windows	154-157

HAND-HELD PC'S			
036	Zeos Int'l	Zeos Contenda	24-25

HARD DISKS			
300	Computability	Mail Order	374-375
•	Hard Drives International	Hard Drives	338-339
•	Insight Distribution Network	Hard Drives	334-337
108	Kingston Technology	Data Card	45
005	Micro Solutions Computer Products	Tape Backup, Disk Drives	193
•	Seagate Technology	200MB Hard Drive	118

HARDWARE			
•	FASTMICRO	Hardware/Software	131-138
•	Hard Drives International	Hard Drives	338-339
•	Insight Distribution Network	Systems	334-337
145	Pacific Wave Technology	Hardware	387
199	PC Zones	Mail Order	382-383
206	TELEMART	Hardware	387

IMAGE EDITING SOFTWARE			
292	Caere Corporation	Image Assistant	104

INFORMATION MANAGERS			
315	Concentric Data Systems	R&R Relational Report Writer	271

LAN ADAPTER BOARDS			
293	3 Com Corporation	TokenLink III	246-247

LOCAL AREA NETWORKING			
254	Artisoft Inc.	LanTastic	203
008	ASP Computer Products	ServerJet	88
323	AT&T Paradyne	Dataport 14.4 Fax Modem	47
300	Computability	Mail Order	374-375
109	COMPUTER DISCOUNT WAREHOUSE	Networking Products	382-383
033	Computer Library	SupportOnSite for Applications	404
002	Digital Products Inc.	Print Director	108
•	Microsoft	Windows for Workgroups	72-73
•	Northgate Computer Systems	Networking Products	319-324
133	On-Track Computer Systems	Network Data Recovery Utility	82
045	Tangent Computer, Inc.	486's, Servers	344
330	Thomas Conrad Corporation	Token Ring Products	117
•	Zenith Data Systems	Network Ready Products	128-127

MAIL ORDER			
209	Anel Design Inc.	Mail Order	348
338	Arlington Computer Products	Mail Order	390
012	Austin Computer Systems	Austin Desktop PCs	13-15
012	Austin Computer Systems	Austin Desktop PCs	147
190	CallSoft	Software	80
388	CallSoft	Software	83
205	Compuclassics	Mail Order Products	379
144	CompuDyne	CompuDyne Desktops	144-145
132	CompuDyne	CompuDyne Notebooks	258-257
300	Computability	Mail Order	374-375
109	COMPUTER DISCOUNT WAREHOUSE	Mail Order	382-383
177	Computer Express	Mail Order	378
316	Comtrade	Systems	367
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
347	DUSTIN DISCOUNT SOFTWARE	Mail Order Products	348-341
119	Edge Technology	PC's	363-366
305	Expo Tech	486 DX2/50 Mhz, 486 SX/25 Mhz	357-359
•	FASTMICRO	Systems	131-138

Advertisers' Index PRODUCTS

Reader Service

No.	Company	Product	Page
•	FASTMICRO	Hardware/Software	131-138
352	FASTMICRO	Hardware/Software	382-383
352	FASTMICRO	Systems	382-383
382	First Source International	Memory	376-377
•	Gateway 2000	Mail Order	207-210
•	Gateway 2000	Mail Order	207-210
277	Global Horizons, Inc.	Systems/Software/Peripherals	391
342	Grid Systems Corporation	GRiD Desktops & Notebooks	106-107
•	Hard Drives International	Hard Drives	338-339
275	Hyundai Electronics	Notebooks	57
086	IBM Corporation	PS/Valuepoint Direct	179-182
•	Insight Distribution Network	Hard Drives	334-337
019	L.A. Trade	Mail Order	394
119	Micron Computers	PC's	363-366
225	MicroWarehouse	Mail Order	309-310
010	Midwest Computer Works	Mail Order	396
112	Mitac	Mitac PC's	354-355
•	Northgate Computer Systems	Mail Order	319-324
145	Pacific Wave Technology	Mail Order, Computers, Hardware	387
029	PC Brand	Mail Order, PC's	194-197
•	PC Connection	Mail Order	250-253
199	PC Zones	Mail Order	392-393
092	PCs Complete	Mail Order	350-352
345	PCs Complete	Mail Order	361
•	Swan Technologies Inc.	PC's	275-276
045	Tangent Computer, Inc.	486's, Servers	344
206	TELEMART	Software, Hardware	397
121	Tri-Star Computers	Systems	346
189	USA Flex	USA Flex Systems	368-369
210	USA Flex	Mail Order/Peripherals	370-371
051	USA Flex	Peripherals	372-373
067	Worldwide Technologies	Memory	386
•	Zenith Data Systems	Mail Order	126-127
036	Zeos Int'l	Zeos Contenda	24-25
115/035	Zeos Int'l	Zeos Z-Card, Z-Quote	33
063	Zeos Int'l	Zeos 486 Eisa	34-35
125	Zeos Int'l	Zeos Freestyle SL/Notebooks	90-91
038	Zeos Int'l	Zeos Color Notebooks	92
151	Zeos Int'l	Zeos Upgradable Systems	32a-32f
MAILING SOFTWARE			
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
MAPPING SOFTWARE			
291	MapInfo Corporation	MapInfo	256
MASS STORAGE			
300	Computability	Mail Order	374-375
378	lomega	MultDisk, LaserSafe Pro	16-17
MEMORY			
382	First Source International	Memory	376-377
391	H.Co Memory Upgrades	Memory	399
108	Kingston Technology	Data Card	45
019	L.A. Trade	Memory	394
213	Sigma Data	Upgrades	219
067	Worldwide Technologies	Memory	386
MISCELLANEOUS			
009	ComputerLibrary	Data Sources	298
MODEMS			
338	Arlington Computer Products	Mail Order	390
323	AT&T Paradyne	Dataport 14.4 Fax Modem	47
300	Computability	Mail Order	374-375
210	USA Flex	Mail Order/Peripherals	370-371
MULTI-MEDIA			
190	CallSoft	Software	80
388	CallSoft	Software	81
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
093	Media Vision	Pro Audio Spectrum 16	51
093	Media Vision	Pro 16 Multimedia Upgrade Kit	53
ON LINE DATABASE			
033	Computer Library	SupportOnSite for Applications	404
070	Ziff Desktop Information	Ziffnet	402-403
OS/2 SOFTWARE			
•	IBM Personal Software Products	OS/2	213-216
PC ACCESSORIES			
005	Micro Solutions Computer Products	Tape Backup, Disk Drives	193
PC DIRECT			
209	Anel Design Inc.	Computers, Mail Order	348
338	Arlington Computer Products	Mail Order	390
205	Computability	Mail Order Products	379
300	Computability	Mail Order	374-375
109	COMPUTER DISCOUNT WAREHOUSE	Mail Order	382-383
177	Computer Express	Mail Order	378
316	Comtrade	Systems	367
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
347	DUSTIN DISCOUNT SOFTWARE	Mail Order Products	340-341
119	Edge Technology	PC's	363-366
305	Expo Tech	486 DX2/50 Mhz, 486 SX/25 Mhz	357-358
352	FASTMICRO	Hardware/Software	382-383
382	First Source International	Memory	376-377

Reader Service

No.	Company	Product	Page
277	Global Horizons, Inc.	Systems/Software/Peripherals	391
391	H.Co Memory Upgrades	Memory	399
•	Hard Drives International	Hard Drives	338-339
•	Insight Distribution Network	Hard Drives	334-337
019	L.A. Trade	Memory, Mail Order	394
119	Micron Computers	PC's	363-366
010	Midwest Computer Works	Mail Order	396
112	Mitac	Mitac PC's	354-355
145	Pacific Wave Technology	Mail Order, Computers, Hardware	387
199	PC Zones	Mail Order	392-393
092	PCs Complete	Computers, Mail Order	350-352
345	PCs Complete	Computers, Mail Order	361
045	Tangent Computer, Inc.	486's, Servers	344
206	TELEMART	Software, Hardware	397
121	Tri-Star Computers	Systems	346
189	USA Flex	USA Flex Systems	368-369
210	USA Flex	Mail Order/Peripherals	370-371
051	USA Flex	Peripherals	372-373
067	Worldwide Technologies	Memory	386
PC-FAX			
323	AT&T Paradyne	Dataport 14.4 Fax Modem	47
PERIPHERAL SHARING DEVICE			
008	ASP Computer Products	ServerJet	88
002	Digital Products Inc.	Print Director	100
150	Dresselhaus Computer Pro	Printer Sharing Device	200
•	Pacific Data Products, Inc.	Direct Net	76
PERIPHERALS			
109	COMPUTER DISCOUNT WAREHOUSE	Peripherals	382-383
•	Epson America	Epson Printers	20-21
•	Gateway 2000	Peripherals	207-210
277	Global Horizons, Inc.	Peripherals	391
•	Hard Drives International	Hard Drives	338-339
•	Insight Distribution Network	Hard Drives	334-337
145	Pacific Wave Technology	Computers, Software	387
PORTABLE/LAP COMPUTERS			
387	Browse	ScreenStar Portable	206
126	CompuAdd	CompuAdd Systems	87-70
128	CompuAdd Express	CompuAdd Express Systems	153
128	CompuAdd Express	CompuAdd Express Systems	162-163
132	Compudyme	Compudyme Notebooks	256-257
109	COMPUTER DISCOUNT WAREHOUSE	Laptops	382-383
•	Dell Computer Corporation	Dell Systems	C5-C8
•	Dell Computer Corporation	Dell Systems	120-121
•	Dell Computer Corporation	Dell Systems	234-235
•	Dell Computer Corporation	Dell Systems	286-287
•	Dell Computer Corporation	Dell Systems	292-293
119	Edge Technology	PC's	363-366
305	Expo Tech	Notebooks	357-358
•	Gateway 2000	Notebooks	207-210
277	Global Horizons, Inc.	Components/Systems	391
342	Grid Systems Corporation	GRiD Convertible & Notebooks	106-107
275	Hyundai Electronics	Notebooks	57
085	Micro Center	WinBook Notebook	101
119	Micron Computers	PC's	363-366
010	Midwest Computer Works	Mail Order, Hardware	396
026	Personica	Laptop Ultravision	4
353	Texas Instruments	TI TravelMate 4000	201
379	Toshiba America	T4500 Notebook	74-75
•	Zenith Data Systems	Notebooks	126-127
036	Zeos Int'l	Zeos Contenda	24-25
125	Zeos Int'l	Zeos Freestyle SL/Notebooks	90-91
038	Zeos Int'l	Zeos Color Notebooks	92
POWER PROTECTION			
162	American Power Conversion	Back UPS	269
080	PC Power & Cooling	Power Protection	265
PRESENTATION SOFTWARE			
•	Lotus Development Corporation	Freelance Graphics for Windows	154-157
•	Software Publishing	Harvard Graphics for Windows	10-11
PRINTER ACCESSORIES			
008	ASP Computer Products	ServerJet	88
•	Microsoft	Printer Systems	228-229
PRINTERS			
338	Arlington Computer Products	Mail Order	390
•	Canon Computer Systems	BJ200 Printer	248
187	Canon, U.S.A.	CJ10	260
137	Compag Computer	Pagemark Printers	86
300	Computability	Mail Order	374-375
002	Digital Products Inc.	Print Director	100
•	Epson America	Epson Printers	20-21
370	Kyocera Electronics	Printer	85
217	NEC Technologies	Silentwriter Laser Printer	94
056	Olivetti	LED Printers	167
001	Tektronix Inc.	Color Printer	41
210	USA Flex	Mail Order/Peripherals	370-371
PROGRAM DEVELOPERS/GENERATORS			
348	Computer Associates	Clipper	43
PROGRAMMERS TOOLS UTILITIES			
133	On-Track Computer Systems	Netware Data Recovery Utility	82

Advertisers' Index PRODUCTS

Reader Service No.	Company	Product	Page
PROJECT MANAGEMENT			
*	Microsoft	Project for Windows	285
148	Primavera Systems	Project Management	58
*	Scitor Corporation	Project Scheduler 5.0	143
188	Symantec Corporation	Timeline	28
RESSELLERS			
205	Compuchess	Mail Order Products	378
108	COMPUTER DISCOUNT WAREHOUSE	Resellers	262-263
168	DUSTIN DISCOUNT SOFTWARE	CD-ROM Products	332
347	DUSTIN DISCOUNT SOFTWARE	Mail Order Products	340-341
277	Global Horizons, Inc.	Systems/Software/Peripherals	381
810	Midwest Computer Works	Reseller	356
SCANNERS/DIGITIZERS			
187	Canon, U.S.A.	CJ10	280
SERVERS			
845	Tangent Computer, Inc.	485's Servers	344
*	Zenith Data Systems	Network-Ready Products	128-127
SOFTWARE			
190	CallSoft	Software	80
308	Computability	Mail Order	374-375
177	Computer Express	Mail Order	378
*	Dell Computer Corporation	Dell Systems, Software	288-287
*	FASTMICRO	Hardware/Software	131-138
283	Macola, Inc.	Accounting & Windows Software	227
385	Manugistics	Statgraphics	177
145	Pacific Wave Technology	Software	387
199	PC Zones	Mail Order	352-353
825	Personics	Laptop Ultravision	4
208	TELEMARK	Software	387
SPREADSHEET/TEMPLATES			
*	Lotus Development Corporation	Lotus 1-2-3 for Windows	102-103
*	Lotus Development Corporation	Lotus Improv	238
*	Lotus Development Corporation	Lotus Improv	241
*	Lotus Development Corporation	Lotus Improv	243
*	Lotus Development Corporation	Lotus Improv	244-245
STATISTICAL SOFTWARE			
385	Manugistics	Statgraphics	177
154	Mathsoft Inc.	MathCad 3.1	183
UTILITIES			
388	CallSoft	Software	83
879	Central Point Software	Windows Utilities	78-79
133	On-Track Computer Systems	Network Data Recovery Utility	82
828	Personics	Laptop Ultravision	4
VERTICAL MARKET SOFTWARE			
154	Mathsoft Inc.	MathCad 3.1	183
VIDEO GRAPHICS/BOARDS			
338	Arlington Computer Products	Mail Order	380
228	ATI Technologies Inc.	ATI Graphics Accelerators	188-189
308	Computability	Mail Order	374-375
210	USA Film	Mail Order/Peripherals	370-371
855	Video Seven	Win.Pro End User	198
WINDOWS SOFTWARE			
295	Borland International	Paradox for Windows	112-115
190	CallSoft	Software	80
388	CallSoft	Software	83
879	Central Point Software	Windows Utilities	78-79
408	Computer Associates	Tedor	5
348	Computer Associates	Clipper	43
315	Concentric Data Systems	R&R Relational Report Writer	271
380	DCA	Irms Workstation for Windows	23
143	Lotus Development Corporation	Ami Pro	81-83
*	Lotus Development Corporation	Lotus 1-2-3 for Windows	102-103
*	Lotus Development Corporation	Freelance Graphics for Windows	154-157
*	Lotus Development Corporation	Lotus Improv	238
*	Lotus Development Corporation	Lotus Improv	241
*	Lotus Development Corporation	Lotus Improv	243
*	Lotus Development Corporation	Lotus Improv	244-245
283	Macola, Inc.	Windows Software	227
154	Mathsoft Inc.	MathCad 3.1	183
381	Micrograph	ABC Flowchart 2.0	56
*	Microsoft	Windows Office	3-3
*	Microsoft	Windows for Workgroups	72-73
*	Microsoft	Fox Pro for Windows	173-175
*	Microsoft	Project for Windows	285
*	Software Publishing	Harvard Graphics for Windows	10-11
*	WordPerfect Corporation	Wordperfect Windows 5.2	129
WORD PROCESSING SOFTWARE/AIDS			
190	CallSoft	Software	80
388	CallSoft	Software	83
408	Computer Associates	Tedor	5
315	Concentric Data Systems	R&R Relational Report Writer	271
143	Lotus Development Corporation	Ami Pro	81-83
*	WordPerfect Corporation	Wordperfect Windows 5.2	129
WORKSTATIONS			
389	DCA	Irms Workstation for Windows	23
213	Signa Data	Upgrades	219

For Additional Categories See MARKETPLACE PRODUCT INDEX page 485.

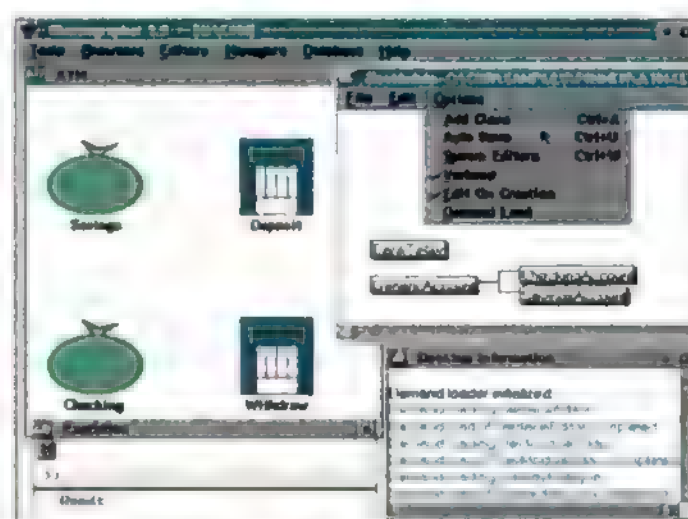


Coming Up

GUI Communications Software

At last, flocks of GUI communications software for both Windows 3.1 and OS/2 2.0 Presentation Manager have arrived. Expectations are high for modem users looking for greater ease of use, but do these packages deliver the goods? The ten packages we review will answer some users' prayers, but may leave others cursing.

Development Tools for OS/2



Choreographer's Display Object Editor lets you draw applications-specific objects.

Corporate IS managers need to get in-house systems up and running quickly and economically. This calls for development tools that recycle reliable code and yield user-friendly programs. Designed from the ground up to work in a cooperative, client-server environment, OS/2 has some special strengths in this area. We look at four front-end applications development tools that let programmers build robust distributed applications for accessing data on a variety of hosts.

Sound is a crucial element in the burgeoning multimedia revolution. Whether you're a musician who wants to equip your PC to handle your professional audio needs, a business professional who wants to snap up your presentations with Beethoven's Fifth, or whether you simply want to add to the realism of a flight simulator, you'll find something to meet your needs. We review 25 boards that range from entry-level offerings with 8-bit sample sizes to the new 16-bit cards that allow recording at the highest sampling quality.

Sound Boards

Sound is a crucial element in the burgeoning multimedia revolution. Whether you're a musician who wants to equip your PC to handle your professional audio needs, a business professional who wants to snap up your presentations with Beethoven's Fifth, or whether you simply want to add to the realism of a flight simulator, you'll find something to meet your needs. We review 25 boards that range from entry-level offerings with 8-bit sample sizes to the new 16-bit cards that allow recording at the highest sampling quality.

Free Utility

In the rush to Windows, some of the powerful features of DOS were left behind. Windows users who long for DOS batch files will welcome WinCmd. WinCmd is our new Utility, a command file interpreter that does batch files and more. All Windows users will appreciate the ease with which you can now create your own Windows programs to automate repetitive tasks. □

Editorial Product Index

Reader Service

No.	Product	Company	Page	No.	Product	Company	Page	No.	Product	Company	Page
468	Actix GraphicsEngine Ultra	Actix Systems Inc.	185	515	Innovative Technology SPIU-8	Innovative Technology Inc.	270	510	Power Management System 64-631	GC-Thorsen Inc.	270
417	Adobe Photoshop Version 2.5 for Windows	Adobe Systems Inc.	59	423	Intel LANDesk Manager, Version 1.0	Intel Corp.	52	500	Power Programming with Microsoft Macro Assembler	Microsoft Press	73
469	Advanced Integration Research Aview 2	Advanced Integration Research Inc.	204	411	Intelli-Plot Turbo II	Advanced Matrix Technology Inc.	64	517	Power Tree 50	Kensington Microware Ltd.	270
470	Advanced Integration Research Aview 2E	Advanced Integration Research Inc.	204	530	Isobar 6 Ultra	Tripp Lite	274	413	PowerMenu Plus, Version 7.0	Brown Bag Software Inc.	86
401	ALR Evolution IV	Advanced Logic Research Inc.	59	516	Joslyn Model 1203-03 Surge Suppressor	Joslyn Electronic Systems Corp.	270	508	PowerTrax 2000	EFI Electronics Corp.	270
539	Appian Technology BitBlazer	Appian Technology Inc.	185	487	Linwen/Gaintec EXA	Linwen Associates Inc./Gaintec	204	526	Proxima Network-Grade Surge Protector Model S500	Proxima Corp.	274
472	Artist Graphics WinSprint 900 Lite	Artist Graphics Inc.	185	404	LSBUS Async I/O System	Gigaset Inc.	60	410	RapidReader CM405ABK	Philips Consumer Electronics Company	64
471	ASL Lightning SVGA	Alpha Systems Labs Inc.	218	421	Lotus Freelance Graphics for Windows Release 2.0	Lotus Development Corp.	38	410	RapidReader CM425ABK	Philips Consumer Electronics Company	64
499	Assembly Language Step-by-Step	John Wiley & Sons Inc.	73	535	Macmillan Dictionary for Children, Multimedia Edition	Macmillan New Media	438	506	Ruby Plus	Curtis Manufacturing Co. Inc.	270
540	ATI Graphics Ultra Pro VESA Local Bus	ATI Technologies Inc.	185	430	Megahertz PCMCIA Notebook Data/Fax Modem	Megahertz Corp.	46	537	The San Diego Zoo Presents... The Animals!	The Software Toolworks Inc.	440
473	ATI Graphics Ultra Pro, EISA Version	ATI Technologies Inc.	200	486	Metheus Premier 801	Metheus Corp.	166	538	Sherlock Holmes, Consulting Detective, Volume II	Icom Simulations Inc.	440
429	Avery Personal Label Printer for Windows	Avery Dennison	54	489	Metheus Premier 928-4M	Metheus Corp.	185	497	SixGraph Wizard 924	SixGraph Computing Ltd.	204
474	Boca SuperX Accelerator VGA	Boca Research Inc.	206	435	Microsoft FoxPro 2.5 for MS-DOS and Windows	Microsoft Corp.	37	408	SmartScreen Message Manager, Version 1.0	Capella Systems Inc.	80
420	BusinessWorks Accounting for Windows, Version 7.2	Manzanita Software Systems	50	490	MicroStep AGC-2075e	MicroStep Inc.	208	522	SpecGuard CGL	Pass & Seymour/LaGrand	274
412	Cache Port	SMJ Electronics	64	491	Mirage Storm 1280/256	Mirage Computer Systems	166	451	SpyWorks-VB, Version 1.0	Desaware	77
475	Cardinal VideoSpectrumXL	Cardinal Technologies Inc.	206	402	Mitsubishi S3600-30U	Mitsubishi Electronics America Inc.	59	528	SRW GS-2	SRW Computer Components Co. Inc.	274
541	Cardinal WARPspeed	Cardinal Technologies Inc.	185	466	MS-DOS 6.0 Upgrade Kit	Microsoft Corp.	111	503	Surge Arrest Plus with telephone suppression	American Power Conversion Corp.	270
410	CDD521GN Desktop CD-Recorder System	Philips Consumer Electronics Company	59	536	The Multimedia Encyclopedia of Mammalian Biology	McGraw-Hill Inc.	439	524	Surge Protector 300 Plus Model 106	Power Sentry Inc.	274
513	Circuit Guard SSB	Hubbell Inc.	270	492	National Design Volante AT800	National Design Inc.	218	504	Surge Reactor BN6-6	Brooks Electronics Inc.	270
476	Colorgraphic Twin Turbo Accelerator	Colorgraphic Communications Corp.	204	542	National Design Volante Warp 10LB-2	National Design Inc.	185	505	Surge Stopper BPS-BN6-6	Brooks Power Systems	270
416	ColorUP for Windows, Version 1.0	Pantone Inc.	86	519	NCR Series 4000 Model 4070	NCR Corp.	274	525	Surgebuster Model 1206K8	ProTek Devices Inc.	274
477	Compaq QVision 1024/E	Compaq Computer Corp.	200	431	NEC MultiSync 5FGe	NEC Technologies Inc.	48	512	SurgePro SP-8000NS	GE Wiring Devices	270
424	CompuAdd 450SLC2	CompuAdd	56	493	Nth S3 Advantage	Nth Graphics Ltd.	166	529	Tandy 8-Outlet Power Center	Tandy Corp.	274
405	CompuAdd Express 425ColorPlus	CompuAdd Express	80	494	Number Nine #9GXE	Number Nine Computer Corp.	185	433	Toshiba TXM-3401E CD-ROM	Toshiba America Information Systems Inc.	54
462	Conversion Artist, Version 1.1	North Coast Software Inc.	238	495	Orchid Fahrenheit VA	Orchid Technology Inc.	166	518	Transient Tamer TT 415	L.E.A. Dynatech	274
507	DataShield S100	DataShield	270	458	Paint Shop Pro for Windows, Version 1.02	JASC Inc.	254	511	Ultimate SRF-6M0/S-DP	Geist Inc., Product Division	270
425	DECpc 486d2 MT	Digital Equipment Corp.	56	521	Panamax Max 6	Panamax	274	496	Video Seven WIN.PRO	Video Seven	186
502	Diagnostic Power Refinery, Model 718	AESI/SteelWall	270	434	Panasonic CF-1000 notebook	Panasonic	49	452	Visual Architect for Visual Basic	FarPoint Technologies	77
479	Diamond Stealth 24	Diamond Computer Systems Inc.	166	501	PC Magazine Assembly Language Lab Notes	Communications & Systems Company Ziff-Davis Press	73	527	Wave Tracker WT8SS	SL Weber Inc.	274
478	Diamond Stealth Pro	Diamond Computer Systems Inc.	185	496	PCG Photon 7070 Deluxe	Personal Computer Graphics	204	543	Western Digital Paradise Accelerator-VL	Western Digital Corp.	185
407	DisplayMate Professional	Sonera Technologies	60	523	Perma Power RS-810	Perma Power Electronics Inc.	274	426	WinCIM	CompuServe Inc.	48
463	DoDOT, Version 4.0	Halcyon Software Inc.	239	432	Philips CDI 350	Philips Consumer Electronics Company	64	459	Window Painters' SnapPRO1, Version 2.03	Window Painters Ltd.	258
480	Edge D24 BitBlaster Plus	Edge Technology Inc.	206	461	PictureEze, Version 2.0, with CaptureEze, Version 1.0	Application Techniques Inc.	228	428	WinSense, Version 1.0	SoftLogic Solutions	50
520	Electricord XP	Pacific Electricord Co.	274	427	Pixar Typestry, Version 1.1	Pixar	44	409	Wizard 9000 VL Bus Graphics Accelerator	SixGraph Computing Ltd.	64
509	Electripak 6SSU	Electripak	270	461	Pizzazz Plus, Version 3.0	Application Techniques Inc.	228	408	Wizard 924 Graphics Accelerator	SixGraph Computing Ltd.	64
481	ELSA Winner 1000	ELSA America Inc.	185	414	PM144000FXMT	Practical Peripherals	66	531	Woods 5823 Surge Suppressor	Woods Wire Products Inc.	274
482	Focus 2 the Max TrueSpeed	Focus Information Systems Inc.	166	414	PM9800FX	Practical Peripherals	66	532	Zaptech Model MSS-206	Zaptech International Corp.	274
403	Fractal Design Painter for Windows, Version 2.0	Fractal Design Corp.	59	414	PM9800FXMT	Practical Peripherals	66	533	Zero Surge ZS1800 Surge Eliminator	Zero Surge Inc.	274
406	Freedom of Press for Windows, Version 3.02	ColorAge Inc.	60								
484	FreezeFrame, Version 1.01	DeltaPoint Inc.	240								
483	Genoa WindowsVGA 24	Genoa Systems Corp.	206								
484	Genoa WindowsVGA 24+	Genoa Systems Corp.	186								
534	Great Wonders of the World, Volume 1	InterOptica Publishing	438								
465	HALO Desktop Imager, Version 2.0	Media Cybernetics	241								
416	HALO Imaging Library for Windows, Version 1.0	Media Cybernetics Inc.	66								
485	Hercules Graphite Card	Hercules Computer Technology Inc.	199								
486	Hercules Superstation XP610	Hercules Computer Technology Inc.	218								
460	HiJaak for Windows, Version 1.0	Inset Systems Inc.	243								
460	HiJaak, Version 2.1	Inset Systems Inc.	243								
422	Hotwin, Version 3.0	TMA Software	46								
456	ImagePals, Version 1.0	U-Lead Systems Inc.	249								
457	ImagePrep, Version 4.0	HSC Software Inc.	249								
514	Inland 3 Mode Surge Protector	Inland Corp.	270								

TECHNICAL COLUMNS

User-to-User	A batch file that lets you sequentially perform a command on a group of numbered files.....	289
Tutor	The Truth About Free System Resources	296
Lab Notes	Communications Programming in Windows 3.1	299
Utilities	Catalog Your Windows Fonts with FNTPRN	306
Environments	Outline Font Selection in OS/2 Programs	313
Power Programming	The Hazards of Exploring Evolving Environments	325

SOLUTIONS

PCs	Should large capacity hard disks be divided into multiple partitions?	342
Operating Environments	How to keep the clock visible in Windows 3.1	343
Operating Environments	Locating graphics accelerators for OS/2	345
Word Processing	Copy equations and then edit them with WordPerfect's editing tools	345
Spreadsheets	A macro that can create 3-D effects on Excel worksheets	347
Databases	How FoxPro's FILE() function really works	349
Databases	A confirmation for the Del key in Paradox	353
Graphics	Getting type to align across multiple columns in PageMaker 4.0	356
Networking	How to make your modem and standalone fax share one phone line	360
Languages	Using high-intensity background colors in BASIC programs	362

After Hours

MULTIMEDIA AT HOME: InterOptica Publishing's Great Wonders of the World, Volume I; Macmillan New Media's Macmillan Dictionary for Children; McGraw-Hill's Multimedia Encyclopedia of Mammalian Biology; The Software Toolworks' The San Diego Zoo Presents... The Animals!; Icom Simulations' Sherlock Holmes, Consulting Detective, Volume II

MULTIMEDIA AT HOME

From Mammals to Mysteries: Five Reasons to Buy CD-ROM

BY RUBIN RABINOVITZ

Ihere are five CD-ROM-based applications that will give you incentive to purchase a multimedia PC.

INTEROPTICA
PUBLISHING

Great Wonders of the World, Volume I

CD-ROM technology can add sound and color to any subject. InterOptica's \$79.95 Great Wonders of the World, Volume I, offers an in-depth introduction to ten of the world's most celebrated sites and structures, complete with video and music.

Six sections of Great Wonders focus on places of archaeological or architectural interest: the Egyptian pyramids, the Inca ruins in Peru, Cambodia's Angkor Wat temple, the cathedral of Chartres, the Taj Mahal, and the city of Venice.

The remaining sections deal with celebrated feats of engineering and construction: the Great Wall of China, the Panama Canal, the Trans-Siberian Railway, and the Empire State Building.

Great Wonders, which

runs under DOS, offers 40 minutes of video, 30 animations, 400 full-screen photographs and illustrations, and 100 maps; the program also has narratives, music, and animations.

At the heart of Great Wonders is a series of multimedia presentations, all of which are accompanied by supportive text. You'll get geographical, architectural, and historical information pertaining to each of the sites, and the program makes it easy to retrieve additional facts on particular topics. Words highlighted in blue can be looked up in a glos-

tures. In addition, you can get travel information about the areas where the Great Wonders are located and use a quiz to test yourself on the topics that have been covered.

The program's video clips are fuzzy, but this is standard fare among CD-ROM-based applications, given the current state of the technology. The slide shows are more impressive, combining vivid illustrations and informative narrations. For the Great Wall of China, for example, you'll see 11 color photographs of its different parts and hear about how it came to be built. For the Chartres cathedral, the slides show its exterior and interior, while the narrative describes noteworthy features.

ROCKY INSTALLATION

Great Wonders does have some problems: Its installation could be smoother, it doesn't run well in DOS sessions of Windows, and its sound levels are uneven because it uses digitized audio for the videos and Red-Book audio for the rest of the program. (The latter problem will be an advantage, however, if you haven't installed a sound board, because you'll be able to hear the Red-Book audio portions through your CD player.)

In addition, Great Wonders is slow: On a 486 system with a fast CD player, it took between 4 and 9 seconds to change slides or to move to a

new program segment.

Nevertheless, you'll probably like Great Wonders—and so will your children. It's attractively designed, easy to use, and provides an enjoyable way of learning about some fascinating places.

Great Wonders of the World, Volume I, \$69.95. Requires: 640K RAM, 1.5MB hard disk space, CD-ROM drive, DOS 3.1, MSCDEX 2.0 or later, sound board, headphones or speakers. InterOptica Publishing, 300 Montgomery St., 2nd Floor, San Francisco, CA 94104; 415-788-8788.

Circle 534 on reader service card

MACMILLAN NEW MEDIA

Macmillan Dictionary for Children, Multimedia Edition

Also designed to engage a child, Macmillan Dictionary for Children, Multimedia Edition, is an attractive program that makes good use of its multimedia capabilities. The dictionary's entries (nearly 12,000) can be sounded out, as can most of the words in the definitions, making it ideal for children learning how to read. The publishers recommend the program for users aged 7 to 12, but it will probably appeal to many children outside that range.

The sound and animation of the program's opening logo are attention-getters, and the definitions are enhanced by 1,000 color illustrations and 400 sound effects. A help util-



Man-made marvels: Great Wonders of the World, Volume I, explores archaeological and architectural feats.

sary, and words in red have hypertext links for displaying additional facts or pictures.

A time line lists important historical dates, maps show the locations of the sites being studied, and floor plans are included for many of the struc-

Macmillan Dictionary

ity and narrated guided tour will quickly get first-time users up to speed.

Macmillan Dictionary runs under Windows and is an easy way to introduce your child to computers. Users can define words by typing them in or, if unsure of their spelling, by clicking through an alphabetical list. Still another way of dis-

letters of a longer word), and Spelling Bee.

BLUSHING BUDDY

One nine-year-old beta tester said his favorite part of Macmillan Dictionary is Zak, an animated character who sometimes pops up to show how he feels about certain words. Zak giggles at *prank*, blushes at *naked*, and yawns at boring words like *and*.

Meanwhile, a 14-year-old product-evaluation specialist said she thinks Macmillan Dictionary is a cool program but pointed out that younger children will find the games too challenging. She's right; the program needs a way to adjust the

vocabulary to suit different age levels.

The only other problem with the program is that it's slow: Even on a 486 with a fast CD player, it took 30 seconds to load the program and 5 to 7 seconds to execute some simple commands.

Macmillan Dictionary is intelligently designed and reasonably priced (\$59.95). It's also one of those rare finds: an educational program that won't bore your child after a few sessions.

Macmillan Dictionary for Children, Multimedia Edition, \$59.95. Requires: 4MB RAM; 2.3MB hard disk space; Microsoft Windows 3.0 or later; CD-ROM drive; MPC-compatible audio board; headphones or speakers; Microsoft CD-ROM Extensions 2.2 or later. Macmillan New Media, 124 Mount Auburn St.,

Cambridge, MA 02138; 800-342-1338; 617-661-2955, Ext. 34; fax, 617-868-7738.

Circle 535 on reader service card

MCGRAW-HILL

Multimedia Encyclopedia of Mammalian Biology

Better suited to a library than the home is McGraw-Hill's newly released Multimedia Encyclopedia of Mammalian Biology. This high-end MPC CD-ROM offers the full text and graphics of the five-volume, 3000-page *Grzimek's Encyclopedia of Mammals* along with new articles written especially for the electronic edition. As its \$995 price and scientific subject matter suggest, it's intended mainly for institutional buyers.

THOUSANDS OF PHOTOS

The Encyclopedia comes with 350 sound clips of different animal calls. There are 3,500 illustrations—256-color VGA photographs, drawings, charts, and maps showing the distribution of animal species. The photographs are notably sharp, but they're also fairly small (typically 3.5 by 3.25 inches on a 15-inch, 800-by-600 monitor); enlarging them makes the resolution suffer considerably.

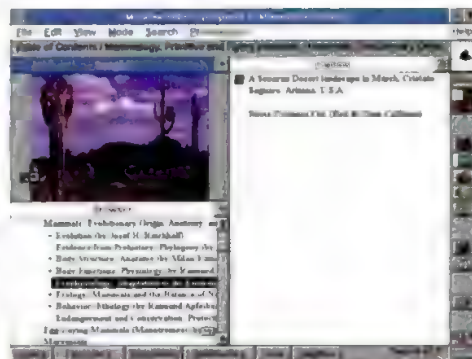
The Encyclopedia comes with 347 video clips—20 minutes' worth of video—from the archives of the BBC. These movies may test the strength of your commitment to mammalian biology, though: To see them, you'll

need a Digital Video Interactive video playback card such as the IBM Action Media II Display Adapter, list price (are you sitting down?) \$1,695.

The Encyclopedia offers many ways to retrieve information: via item, taxonomic group, geographical distribution of species, or biological concept (such as behavior, ecology, or evolution). It utilizes both simple and complex search routines. You can display the program's numerical data in graph or chart form; text can be printed or it can be saved to disk.

Compared to other CD-ROMs, the Encyclopedia is sluggish, even on a fast platform. Equally frustrating are glitches and a cryptic interface that will leave you scratching your head. The program's index doesn't work, but a fix is promised for the next release.

You can retrieve information from the glossary by using the Lookup button; hitting the

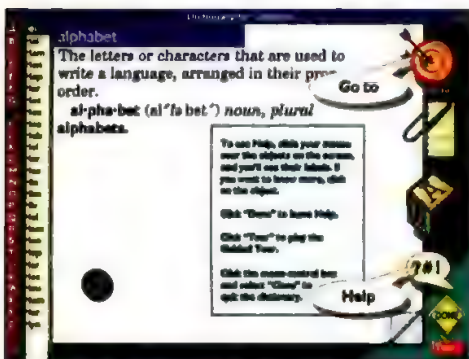


The Encyclopedia of Mammalian Biology features 3,500 illustrations of animals and their habitats.

Glossary icon—the logical command—forces you to click through thousands of items to reach those at the end of the alphabet.

Most CD-ROM reference programs can be learned on the fly, but not this one; plan on an intimate session with the manual before you expect to get up to speed.

In general, the content of



A to Z: Macmillan Dictionary for Children lets you type in a word or use an alphabetic list.

playing definitions is by moving back and forth through the dictionary from one entry to another. Clicking the right mouse button on a word in a definition gives its meaning, a feature that makes cross-referencing a breeze. For many entries, the definition is followed by a sample sentence so that your child can see the word in context. Some words also have brief histories (e.g., *rebel* is from a Latin word meaning to make war again) as well as notes on usage (e.g., *made* is pronounced the same way as *maid*). Future Noah Websters can compile their own vocabulary lists based on the dictionary's entries, a useful option for learning new words.

The program comes with three games that draw from the dictionary's extensive database: Hangman, Words Within Words (in which you make short words from the

Mammalian Biology

the Encyclopedia is useful and workmanlike, but the implementation needs improvement. Bugs will doubtless be eliminated in future releases, and the developers may see the marketing wisdom of a video format that doesn't require an expensive playback card. Until then, be guided by a familiar axiom of software purchasing: All good things come to those who wait until after the 1.0 release.

The Multimedia

Encyclopedia of Mammalian Biology, \$995. Requires: MPC-compliant computer with 4MB RAM, DOS 3.3, Windows 3.0, MSCDEX, CD-ROM player, 2MB hard disk space, super-VGA monitor. McGraw-Hill Inc., 11 West 19th St., New York, N.Y. 10011; 800-722-4726, 212-337-5961; fax, 212-337-4092.

Circle 536 on reader service card.

THE SOFTWARE TOOLWORKS

The San Diego Zoo Presents... The Animals!

If visits to the zoo are high on your list of preferred family activities, you'll like The Software Toolworks' The San Diego Zoo Presents... The Animals! The Animals! packs 1,300 color photos, 2.5 hours of audio, 2,500 pages of text, and 60 minutes of color video (in 80 video clips) onto a single CD-ROM disk.

While The Animals! resembles National Geographic's The Mammals, it's a better value; it's both bigger (with more text and multimedia segments) and cheaper (\$119.95 versus \$150).

The photographs in the MPC version of The Animals!

are crisp Super VGA color images, and the videos utilize Microsoft's new Video for Windows (also known as AVI). This 15-frame-per-second digital video technology presents sharper images than other CD-ROM video formats—PhotoMotion, for example. Video for Windows supports the synchronous playback of audio and video clips over a variety of MPC platforms; as a result, when you watch the video of a baby chimpanzee being tickled, you'll also hear its laughter.

The Animals! covers about 200 mammals, birds, and reptiles. The main menu, a three-dimensional map of the zoo, makes it easy to find any of the program's 350 animal and habitat exhibits. Various areas of the map represent different biomes—bioclimatic zones such as desert, tundra, and tropical rain forest.

Other images on the map represent specialized parts of the program. The Information Center helps you navigate through the program, the Nursery has segments on how young animals are cared for, and the Tour Bus takes you to narrated tours such as "Fact or Fable," during which you will learn that camels don't really store water in their humps and other interesting facts.

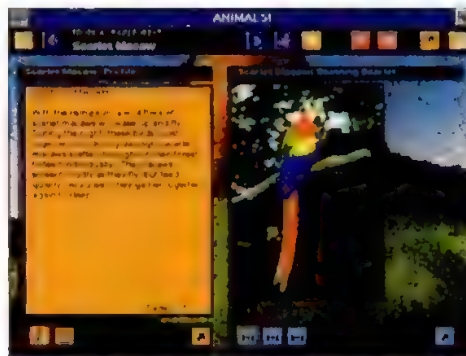
Clicking on an alphabetical list brings information and hyperlink buttons offering additional animal facts and photos. Other buttons take you to new exhibits, a keyword search, and the media library, which lists the program's

maps, videos, pictures, and animal sounds.

The Animals! touches base with contemporary ecological concerns in segments dealing with the protection of endangered species and the destruction of the tropical rain forest. There are also special features for children, such as a quiz and narrated stories about the zoo's animals.

NECESSARY SACRIFICES

The few shortcomings you'll encounter are those The Animals! shares with other CD-ROM packages. So much space is needed to store multimedia files that sacrifices are necessary, even on a 680MB CD-ROM. Thus, The Animals! runs in a 640-by-480 box, which means that the program can't be displayed in a full-screen window at higher resolutions. The color photos are typically 319-by-268 (3 by 4 inches on a 15-inch SVGA monitor). The videos are played in even smaller 160-by-120 windows (2 by 1.75



The Animals! offers illustrations and text, as well as buttons that let you move to related pictures and topics.

inches). You can configure the program to play the videos in a 320-by-240 frame, but this brings a proportional degradation of resolution.

Another glitch is related to the new Video for Windows technology: The movie playback may seem jerky on some systems because frames must

be dropped to synchronize video and audio segments.

A DOS version of The Animals! is also available; it requires 570K of free RAM, uses a new video technology for DOS developed by Total MultiMedia (TMM), and comes with a 16-color palette instead of a 256-color palette for its background art. The initial DOS version of The Animals! (Release 1.01) had some sound problems, but these will probably be fixed in subsequent releases.

In general, you'll be charmed by The Animals! Its movies, photographs, sound, and text will provide enough variety to interest animal lovers of all ages.

The San Diego Zoo

Presents... The Animals!, \$119.95. Requires: 4MB RAM, DOS 3.3, Windows 3.1, CD-ROM player, MSCDEX 2.1, 2MB hard disk space. The Software Toolworks Inc., 60 Leveroni Ct., Novato, CA 94949. 800-845-8698, 415-883-3000; fax, 415-883-3033.

Circle 537 on reader service card.

ICOM SIMULATIONS

Sherlock Holmes, Consulting Detective, Volume II

Multimedia mystery fans, grab a magnifying glass. It is August 17, 1888, and from the comfort of your town house on Baker Street, you peruse *The Times*. Two stories catch your attention. One is about the senseless shooting of two circus lions in Hyde Park; the second reports the poisoning of a first officer of the Aberdeen Shipping Co. Could there be a connection?

Of course there is. This is Icom Simulations' Sherlock Holmes, Consulting Detec-

Sherlock Holmes II

tive, Volume II, and you've stumbled into The Case of the Two Lions. Icom's highly acclaimed Sherlock Holmes series is interactive CD-ROM gaming at its finest. You and Dr. Watson pick through clues by reading newspapers, consulting your files, and visiting suspects and informants.

What makes this a unique experience is the 90 minutes of full-motion video that leads you through the plot. You watch and listen to Inspector Lestrade as he tells you about the two lions. The action continues in the stables, at the crime scene, and

at several other locations.

Video clips play at 15 frames per second in a TV/VCR window, and users can start, pause, and stop the action. A welcome improvement since Holmes I is a slide bar that lets you back up and repeat any portion of the clip.

For consistency, this disk has many of the same characters and actors as the first volume featured. There are, how-

ever, more scenes. They are also of a shorter duration, which makes for a faster pace.

The video is better too. It was shot with brighter lights and higher-quality film; a new compression technique results in sharper playback and smoother motion than the first volume.

A "live" judge was also added, to whom you must eventually report your solution to the case. This jurist is stubborn and won't listen to hunches; if you haven't collected the evidence to support your allegations, he won't accept your solution—even if it's correct.

The Case of the Two Lions is the most difficult of the three mysteries in Holmes II; some sleuths solve it in just six hours, while others take weeks (20-30 hours seems average). The other two cases on the disk—

The Pilfered Paintings and The Murdered Munitions Magnate—are easier to solve but equally as enjoyable.

Be aware that you'll need a relatively fast CD-ROM player to do justice to the video. Icom recommends a 150-kilobit-per-second transfer rate and a 380-millisecond (continuous read) access time. To its credit, the program doesn't install anything on the hard disk; Holmes II is played solely from the CD-ROM.

—Donald B. Trivette

Sherlock Holmes, Consulting Detective, Volume II, \$69.95. Requires: 640K RAM, mouse, CD-ROM drive, sound card, DOS 3.3 or later. Icom Simulations Inc., 648 S. Wheeling Rd., Wheeling, IL 60090; 800-877-4266, 708-5110-4440; fax, 708-459-7456.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Robin Raskin

New Product Watch

The Norton Desktop for Windows with Support for Windows for Workgroups—or TNDFWWSFWFW for short.

Amazing Facts

Microsoft's Windows NT development is being lead by Dave Cutler, but did you know that Cutler was also the primary developer of DEC's VMS operating system? Back up one letter for each letter in WNT (W becomes V, N becomes M, T becomes S) and you get VMS.

"If you have a one-gigabyte hard drive—and who doesn't yearn for one that large?—you can double it. Two gigabytes means two billion bytes of data. That is almost enough to run OS/2." —*SOUTH CHINA MORNING POST*, DECEMBER 8, 1992

Actually, Barbara's Down In Houston Setting Up a RAID 5 Disk Array

"In response to a subpoena from a special prosecutor, the data storage devices of computers throughout the White House were removed in the closing days of the Bush administration. . . .

"The so-called hard disk drives. . . are in the possession of the FBI. . . As a result, Clinton staffers arrived at their new offices only to find gaping holes in computers everywhere in the White House."

—*THE WALL STREET JOURNAL*, JANUARY 22, 1993

Spotted in the Press Room At the Windows-OS/2 Show

Refreshments and computer equipment provided courtesy of Apple Computer Corp.

Oh, We Thought It Was A Toilet Seat with a Built-in Cellular Phone

Forminco's Mouse Arena mouse pad features a "unique TYRON textured surface," "dual work planes," a "soft glove leather palm support," and a "cord control system." (Brossard, Quebec, Canada; 514-444-9488.)

10 YEARS AGO IN PC MAGAZINE And It Only Cost \$60

IBM's new disk operating system supported "PC-XT hardware features and delivered pipes, filters and trees to everybody." DOS 2.0 arrived on two single-sided double-density disks.

Overheard

"We've added SEX to LapLink."

—*TRAVELING SOFTWARE CEO MARK EPPLEY, DESCRIBING THE NEW SMART EXCHANGE FEATURE IN LAPLINK V*

"It's like a space heater with a monitor."

—*PC MAGAZINE ASSOCIATE EDITOR BRIAN NADEL, DESCRIBING HIS 66-MHz DX2 SYSTEM*



Richard Tennant



In the spirit of friendship and cooperation. . . on one side of the official NetWorld totebag: IBM; on the other side: Microsoft.

If your entry is used in Abort, Retry, Fail? we'll send you \$50 and a PC Magazine T-shirt. Winners this issue: Richard Fiorentino (NT roots), Don Willmott (totebag wars), Barry Simon (Macinized).

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